Programmatic Environmental Assessment of Small-Scale Irrigation in Ethiopia

Prepared by
Tom Catterson
Ato Moges Worku
Ato Messel Endalew
Carmela Green Abate
Frank Brockman
Ato Abebe Wolde Amaneul
Ato Kibru Mamusha

For
Catholic Relief Services
U.S. Catholic Conference
Baltimore, Maryland

On behalf of the following Cooperating Sponsors
Catholic Relief Services/Ethiopia
CARE/Ethiopia
World Vision International/Ethiopia
Food-for-the-Hungry International/Ethiopia
Relief Society of Tigray
Ethiopian Orthodox Church

September 1999

U.S. Agency for International Devlopment
Bureau for Africa
Office of Sustainable Development
and the
Bureau for Humanitarian Response
Office of Food for Peace

Catholic Relief Services
U.S. Catholic Conference

Contents

Foreword

The programmatic environmental assessment option has been part of USAID's environmental regulations for some time. The present exercise, however, appears to be the first instance wherein this approach to environmental review has been applied to small-scale irrigation and led by a PVO. As such, all concerned have been "finding their way" and doing their best to make both the exercise itself and this outcome – this report – useful.

By its own initiative, Catholic Relief Services took on this PEA with P.L. 480 Title II resources provided by BHR/FFP through an Institutional Strengthening Grant. This decision on the part of CRS and BHR/FFP was enthusiastically endorsed by the Bureau for Africa, through REDSO/ESA in Nairobi and the Office of Sustainable Development (AFR/SD) in Washington. CRS viewed the PEA as a proactive mechanism to produce and achieve environmentally sound, formally approved general guidelines which can be used in project design/implementation for small-scale irrigation. The PEA is meant to be of benefit not only to CRS but also to other PVO programs worldwide. In Ethiopia, CRS explicitly undertook this PEA on behalf of all the Cooperating Sponsors implementing SSI. CRS entered into this enterprise fully cognizant of the challenges it presented.

It is important to keep in mind the sensitivities of other Cooperating Sponsors and their staffs who are working tirelessly – at times, against seemingly insurmountable odds – to make a difference in food security for the countless numbers of rural people in the country who need their help. Against this back-drop, and humbled by the courage and commitment of the personnel and communities involved in these programs, this report is accordingly tendered with all modesty and with all due respect to those who are truly on the front lines of development in Ethiopia.

It is also important at the outset to understand and to reiterate what this report represents. It is necessary to emphasize that the PEA was not an environmental performance evaluation, but rather a program level effort to identify key "lessons learned" from real field experience – what works and what does not in term of ensuring sustainable small-scale irrigation investment and development and avoiding negative environmental impacts.

The PEA Team took considerable pains to ensure that the exercise was interactive (team work amongst themselves and with other stakeholders) and collaborative (continually discussing the impressions of findings with other Cooperating Sponsors and donor representatives) so as to learn together through a frank and proactive exchange of views and information. This is essential in ensuring that these efforts were carried out in the fullest sense of public consultation and transparency. The team was trying to identify recurrent design, construction, operations and other issues which lead to negative environmental impacts and/or lack of project sustainability. The intention was not to re-invent the general guidelines to successful small-scale irrigation in Ethiopia – nor to write the manual or book on small-scale irrigation and how to do it.

The "program" notion of this Programmatic Environmental Assessment (PEA) comes from a sense of a real program and its successes and short-comings – not a theoretical or idealized view of small-scale irrigation in Ethiopia. CRS is taking the lead in this PEA exercise, being carried out in three countries – Ethiopia, Guatemala and India – because it remains interested in and committed to the important notion that "Doing Good is not Good Enough." It is the sincere hope of all those involved in preparing and carrying out this PEA, that these efforts will help all to go "beyond compliance" in using environmental review as the foundation of these small-scale irrigation programs.

Readers desiring copies of this document may go to the Africa Bureau AFR/SD website at http://www.afr-sd.org/pub.htm or the Food Aid Management website, http://www.foodaid.org.

Dennis Weller, Chief
Agriculture, Natural Resources and Rural Enterprise
Office of Sustainable Development
Bureau for Africa
U.S. Agency for International Development

Acknowledgments

More than one hundred people have directly contributed to this exercise and to the learning about environmental issues and sustainability in the practice of small-scale irrigation. They came from across the development spectrum – from participants in the villages to the program leaders and donor representatives in the capitals. Virtually every one of them with whom the team spoke, did so frankly and earnestly. It was almost as if there were a pent-up urge to address these very timely topics of effectiveness and efficiency, program quality and the impacts on and of the environment as these relate to the struggle for enhanced food security. Their willingness to delve into what might have otherwise been seen as sensitive matters related to environmental impacts is testimony to both their commitment to development and their professionalism.

It would be impossible to thank each and every one of them individually. The PEA Team hopes that its efforts in rendering the collective findings of this exercise will do justice to the many who assisted and facilitated this work. The team must, however, acknowledge the special assistance received from Ms. Dorrette Lyttle-Byrd, Country Representative, and the staff of CRS/Ethiopia without whose numerous contributions this work would not have been possible. We are particularly grateful to Mr. Bob Leavitt, Assistant Country Representative for Programs, whose solicitous concern and high level of interest in the outcome of the PEA were manifest on a daily basis. The three CRS drivers, who guided us safely, tirelessly and efficiently over more than 6,500 kilometers of rugged terrain during field sight visits, showed us all what it really meant to make a contribution to development.

The PEA Team is also grateful to the many field teams of our partner Cooperating Sponsors who unfailingly offered hospitality, collegial exchange and kindred spirits. Their dedication and commitment to their humanitarian work, often under difficult circumstances, sometimes far from home and family work, as mentioned above, is awe-inspiring. May they continue to succeed in their mission of succor and aid to the meek of the earth.

This PEA Report must also acknowledge the leadership of Drs. Gaye Burpee, CRS Headquarters, and Tom Remington, CRS Regional Office, Nairobi, in conceiving and initiating this study, and that of Dr. Walter Knausenberger, USAID/AFR/SD, who has consistently sought to provide practical, professional and collegial assistance to all those concerned with ensuring the environmental soundness of Title II programs. Likewise, thanks to all the reviewers of this PEA for their thoughtful input. Mr. Paul Desrosiers, BHR Environmental Officer, has always been cheerfully supportive.

Thanks goes to USAID/AFR/SD for supporting the editing and printing of this document and to Amiee Henderson of AMEX International for her excellent editorial support.

Last but far from least, the PEA Team Leader must recognize the efforts of the one team member, Ms. Charlotte Bingham, whose continuing encouragement, advice and support was unflagging. As the USAID Regional Environmental Officer in REDSO/Nairobi, she defines the term “virtual team member.” It would be fair to say that without her, this PEA exercise could not have been accomplished. Her impact is on every page of this report.

For more information, please contact:
Program Quality and Support Department,
Catholic Relief Services,
209 W. Fayette St.,
Baltimore, MD 21201-3443.
Telephone: 410-625-3178.
E-mail: gburpee@catholicrelief.org

Executive Summary

Introduction

The report which follows records the outcome of a Programmatic Environmental Assessment (PEA) of Small-Scale Irrigation (SSI) activities funded with USAID/Ethiopia-provided Title II resources. The PEA was carried out by Catholic Relief Services (CRS) on behalf of the five other Cooperating Sponsors (CARE, World Vision International, Food-for-the-Hungry International, Relief Society of Tigray, and the Ethiopian Orthodox Church) currently promoting SSI as an option to achieve enhanced food security in target areas of the country.

SSI and Food Security

Small-scale irrigation has become part of the programs of these Cooperating Sponsors in recent years as they sought to find more sustainable measures for addressing chronic food security vulnerability in the rural communities to which they have been providing relief assistance for decades. The potential for harnessing community willingness to work toward the means – creating productive assets and infrastructure – to produce more food consistently in the drought-prone, food insecure areas was also seen as a means to avoiding the dependency problems sometimes associated with food aid recipients. Similarly, these new activities were seen by both the Cooperating Sponsors and USAID as a means of validating years of efforts at natural resources management accomplished with food-for-work based relief programs.

Rationale for the PEA

USAID's environmental regulations (22 CFR 216), commonly known as Reg. 216, establish the conditions and procedures for environmental review of the activities funded with Agency resources. In late 1996, the Agency determined that these regulations needed to be more consistently applied to P.L. 480 (Food for Peace) activities. Although Title II disaster-related activities are permitted exemptions in Reg. 216 and emergency activities were often funded with authority to proceed "not withstanding" various Agency regulations, any other Title II food-assisted activities were always subject to Reg. 216 (although the documentation was infrequently prepared). As Title II funds became increasingly used for development activities, in line with the transition along the "Relief to Development" continuum, the Agency clarified the applicability of Reg. 216 to food-assisted development and required, prior to the end of FY 98, full compliance with the Agency's environmental procedures.

Accordingly, both USAID and the Cooperating Sponsors began a process, including the exchange of information and a series of training workshops to respond to this mandate. One of the conclusions that emerged from these efforts was the recognition that certain activities typically part of the Title II funded program in Ethiopia would fall within the "class of actions normally having a significant effect on the environment" [216.2(d)] as defined by the regulations. One of the most notable of these classes of actions, and one shared by the majority of the Cooperating Sponsors in Ethiopia, is "irrigation or water management projects, including dams and impoundments," [216.2(d)(ii)] which require a formal Environmental Assessment.

Despite the fact that these actions were typically small in scale, a Positive Threshold Decision for this class of actions would normally be the outcome of the Initial Environmental Examinations prepared by the Cooperating Sponsors. In order to allow this important program component to proceed, the Environmental Officer for the Bureau for Humanitarian Response concurred with recommendations from the Mission and the sponsors that the Initial Environmental Examination would propose a Negative Determination with Conditions for all FY 99 irrigation activities and a Deferral [216.3(a)(iii)] for all such activities in the out-years of the respective DAPs. The primary condition for these Negative Determinations, beyond the stated mitigation and monitoring measures was to carry out a Programmatic Environmental Assessment (PEA) of small-scale irrigation. It was recognized that the PEA procedure [216.6(d)] would have good applicability to the situation of the USAID Title II Cooperating Sponsors because the mechanism was specifically foreseen "as appropriate to....assess the environmental impacts that are generic or common to a class of agency actions."

Purpose of the PEA

This PEA has multiple objectives:

- Facilitate and encourage the identification of environmental issues early in the planning cycle; designing environmental improvements into these activities and thereby avoiding the need to mitigate or compensate for adverse impacts.
- Advance an understanding of the state-of-the-art of sustainable small-scale irrigation, by developing a document that will be useful to USAID and Cooperating Sponsors (and others working with these types of investments) in determining whether or not to proceed with small-scale irrigation development and how to efficiently and effectively plan and manage these activities.
- Build staff capabilities and organizational systems which lead to more sustainable small-scale irrigation systems.
- Facilitate the ability of the Title II Cooperating Sponsors and USAID/Ethiopia to comply with the statutory requirements of Reg. 216 as they apply to their small-scale irrigation activities.

PEA Methodology

This Programmatic Environmental Assessment was carried out along the lines of a conventional environmental assessment, complete with a scoping period and public consultation with a wide variety of stakeholders. It differed from an EA in that it examined small-scale irrigation as a generic class of actions, rather than an in-depth assessment of a particular set on activities on a particular site. The intention was to develop a set of lessons learned regarding small-scale irrigation and adverse environmental impacts and how to deal with them.

A seven person multi-disciplinary team visited approximately 30 different sites where SSI was being developed or was in operation, including sites of each of the Cooperating Sponsors as well as other schemes being implemented by the Regional Commissions for Sustainable Agriculture and Environmental Rehabilitation, throughout the Ethiopian highlands during four weeks of field trips. Debriefing sessions were held with the senior staff of the Title II Cooperating Sponsors and with USAID FFP staff. An early draft of this report was circulated for review and comment.

Findings

The field work, discussion and public consultation, literature review and analysis revealed that the present SSI schemes present a set of recurrent concerns and issues related to **both the issues of adverse environmental impacts and basic feasibility issues**. The analysis which follows may in some cases contradict the conventional wisdom of the environmental assessment/small-scale irrigation literature. The PEA Team felt that the limited literature available on the topic often repeated a litany of very conventional concerns that are unrealistic in the Ethiopian context and in the diagnosis of problems and presumptions about solutions.

Environmental Issues

The following environmental issues, some of which have multiple dimensions, were identified:

- **Inefficient Use of Water – a Precious Resource**: Sub-optimal use of limited surface water run-off being channeled into small-scale irrigation schemes was observed on numerous occasions within the series of sites visited. There were two main reasons for this inefficient use of water:
- Leakage **from unlined canals, through the earthen dam structure, or from breakages in the canal system; and**
- Faulty use of irrigation water **– over-watering in flood irrigation regimes.**

Water lost to the system has a number of serious implications and is a classical dilemma of irrigation technology. Presuming a reasonable match of available water to crop water requirements and total command areas, water losses will lead to diminished production increases because there will not be enough water to irrigate the entire planned command area. Over-watering – using more water than is required for satisfactory crop production – can cause the same effect, exacerbating the challenge of meeting the needs of both "head and tail-enders" within the irrigated perimeter. It may also lead to inefficient use of fertilizers and over-leaching of soils, or creating proper conditions for pests, thereby reducing crop productivity and leaving soils more degraded.

Furthermore, water leakage and over-watering can lead to localized water-logging and/or salinization. Water leaking out of canals and below dams can give rise to pools of stagnant water that provide breeding areas for water related disease vectors. This issue can become particularly acute during dry season irrigation when water availability declines because of poor rainfall in the catchment area, diminished run-off or high levels of evaporation from dam reservoirs.

- **Soil Fertility and Quality Maintenance Problems:** Irrigation increases cropping intensity and increased removal of nutrients from the soil. If nutrients are removed more rapidly than they are replaced, the system is not stable, the soil resource base degrades and crop yields are reduced. Intensive cropping can lead to deficiencies of both the three major elements, nitrogen, phosphorus and potassium, as well as minor or trace elements such as sulphur and zinc. Similarly, it is important to bear in mind that irrigation water can leach soluble nutrients from the root zone, particularly if applied in excess of crop water requirements.

- **Soil Salinity Problems:** Perennial irrigation invariably raises the water table. Dissolved salts are transported by capillary action into the root zone, deposited on the soil surface and left behind when water evaporates. Excess salt inhibits plant growth by disturbing osomotic relations in the root zone, causing declines in crop productivity. More specifically, salinity affects agricultural soils by destabilizing their structure, affecting microbial life with consequent declines in porosity. It affects plants by decreasing the available water for plant growth, deregulating mineral uptake and causing physiological stress.

  Salinization of irrigated lands can be caused by applying saline water, can be the result of naturally saline soils or can occur because waterlogging causes a buildup of soluble salts at the surface. Existing salinity problems are further exacerbated by conditions that lead to high water tables, such as impeded drainage, stagnation of water in low-lying parcels or field depressions, regular seepage from higher elevations, leakage from canals or earthen dams, and excessive application of irrigation water in undrained fields.

- **Soil Erosion**: Erosion within the irrigation command area has several detrimental effects. These effects include depletion of soil nutrients and organic matter when topsoil is carried away, washing crop seeds downslope, exposure of plant roots and degrading downstream water sources when run-off spills out of the command area. Over the longer term, if erosion persists, it will result in reduced topsoil depth, which will affect soil water and nutrient holding capacity of the crop soils and favorable soil structure for root development. Typically, slopes between two and five percent can be satisfactorily irrigated, provided that the plot layout is appropriate and bunding and terracing are practiced. Slopes above five percent need specialized land leveling and terrace construction. Although this may be feasible, it adds considerably to the labor burden on small farmers. In some cases, plot size and animal traction plowing capabilities are inadequate for dealing with land leveling needs within the command area.

  Large amounts of soil excavated from near the dam sites leave borrow pits and areas that are easily eroded. The unprotected and often unconsolidated soils of these areas then wash down into the reservoir basin accelerating the filling-in of the dead storage (and even the live storage) capacity of the scheme, lessening the effective life of the dam.

- **Water Related Disease Hazards**: Primary health risks associated with small scale irrigation projects relate to water and vector borne diseases. In the preparation of their IEEs, Cooperating Sponsors indicated both significant concern and understanding of these health-related environmental impacts. Accordingly, reflecting this concern and the implicit contradictions of human health impacts from development activities and the fundamental humanitarian goals of the partner organizations, the assessment team paid a good deal of attention to these matters.

  The main diseases of importance in the Ethiopian context are malaria, schistosomiasis, water borne disease (gastroenteritis, intestinal parasites, typhoid, etc.) and lymphatic filariasis. Onchocerciasis has been reported in very limited locations in the extreme south western part of Ethiopia. There are four main categories of disease associated with water:

  - Disease prevented by washing and bathing;
  - Disease prevented by clean water supply and sanitation;

- Disease acquired by water contact; and
- Disease acquired from insect bites.

The three latter groups can be adversely affected by water development projects but can be prevented to some degree through good environmental management and proactive planning. Water contact diseases, such as schistosomiasis, depend on intermediate hosts with transmission occurring when people have contact with infected water. Projects that increase the likelihood of pools of stagnant water provide rich breeding grounds for malaria carrying mosquitoes. Projects which require large numbers of construction workers run the risk of increasing exposure to disease through contaminated potable water and poor sanitation facilities.

- **Displacement and/or Changes in Land-Use Patterns and Social Equity:** Establishing a small-scale irrigation system of any type will lead to land-use changes. Some of these changes, for example, converting rainfed farming areas to irrigated plots, will be purposeful, socio-economically acceptable, and environmentally beneficial. They constitute an effort to optimize the productive potential of the area through the sustainable management of two important natural resources – land and water. Benefits notwithstanding, however, it is the unintended impacts that give cause for concern, namely those associated with displacement of people as a result of the construction, shifts in access to the irrigated land, disruption of downstream user access to water resources, and changes in food security and/or dietary habits of local people. It is an example of the basic question of "who pays/who gains?" that must be carefully examined and addressed.

Table 5.4: Environmental Impacts of Small-Scale Irrigation in Ethiopia later in this report provides an overview of the above issues and identifies monitoring and mitigation practices for each. Chapter 5 discusses anticipated impacts, identified during the scoping exercise, that did not emerge during the course of the PEA. They include the following: biodiversity conservation concerns, blocking movements of people or animals, land tenure and land-use conflicts, overpumping of groundwater, and pesticide use.

Sustainability Issues

Ideally one applies environmental review to activities that are expected to be reasonably effective and efficient in achieving the results for which they were designed. In the case of Title II programs, this goal is to achieve improved food security. During an environmental assessment, however, it is important to identify other issues which may be contributing to negative environmental impact but which are more directly related to the feasibility or sustainability of the activity being scrutinized. One does not "mitigate" mistakes; one avoids or corrects them.

The issues ("lessons learned") mentioned here were identified as the result of observations and dialogue in the field. In all cases, there were recurrent examples; individual cases or extremely localized issues were not included in this list. Looking at things from a broadly defined, multi-disciplinary "environmental" perspective forces one to see things holistically and connect cause and effect. The sustainability issues included:

- **Policy, Programming and Planning Issues:** This PEA identified a number of over-arching concerns, related to the nature of the Title II program itself, including:
  - **SSI Potential in Food Insecure Woredas:** Many proponents acknowledge that the bio-physical and socio-economic circumstances (drought-proneness, rugged topography, high population density and geographic isolation) which create the conditions for food insecurity, also limit the placement of SSI. It has been estimated that the area with potential for irrigation in these woredas is a maximum of 5 percent of the total area. Decisions about the role of SSI within food security programs should be based on an understanding of the percentage of program resources that SSI absorbs compared to the number of beneficiaries.
  - **SSI and its Fit within the DAP Approach:** The amount of advance data and information collection and community involvement in planning may not be fully compatible with the five year time frame of the DAP/PAA approach. It has been suggested that in order to be certain of the feasibility of SSI on a given site, a minimum of two years advance efforts may be essential.

- **Present Water Resources Policy Initiative and Title II:** The substantial experiential base and skills of the Cooperating Sponsors is a profound resource that should be tapped for the present national dialogue on a coherent water resources policy.

- **Moving Environmental Considerations to the Field:** The Team is convinced that in order to encourage early adoption of more environment-oriented planning for all activities, the responsibility for preparing the IEE should move to the field. In the case of SSI, only the field staff will be fully able to correctly execute the Environmental Planning Checklist (see Section 7.2) that is the heart of future IEE submissions for SSI.

- **Economics of Small-Scale Irrigation:** Although many project personnel and SSI proponents seemed conversant with the concepts of cost/benefit analysis, the PEA Team was unable to identify a single instance where it might have been realistically applied to the planning process associated with a given scheme. The PEA Team is convinced that further clearer thinking and analysis about the economic dimensions of SSI would assist in improving both the ability to replicate these activities from one site to another as well as the sustainability of the activity in general.

- **Poor Hydrological/Meteorological/Water Resources Assessment Data:** SSI activity designers and planners are faced with a lack of good data on the hydrology of the stream/river system that will be their water source and on local weather and climate conditions. Stream gauging stations are virtually non-existent in remote rural areas of Ethiopia; meteorological stations are almost as rare. Cooperating Sponsors will have to be proactive on issues of water supply assessment and availability; otherwise they will remain the "Achilles' heel" of SSI.

- **Enhanced Community Participation- a Development Objective:** Traditional irrigation is an old art in some parts of Ethiopia. By definition, the act of irrigation, whether formal or informal, is characterized by group interactions associated with human behavior. Within the new schemes developed by Cooperating Sponsors and other organizations working in SSI, the conventional model for community organization and participation is the water user committee or association. Although similar in intent to traditional approaches, these new organizations seem relatively weak (and are so described by many proponents). Most have been imposed on the community and are only formed after the completion of the scheme.

- The present situation is both "top-down" and "top-heavy." SSI was one of the development responses to the concern about food aid dependency; program dependency can be just as bad. Irrigation is a "social act," and those seeking to promote and develop it will need the right mix of skills and attitudes to address both technological and community dimensions. Adding this "keystone" – genuine participatory management capabilities – through a functional Water Users Association or Committee, should be one of the defined and measurable objectives of SSI development.

- **Institutional Compartmentalization and the Institutional Framework for SSI**: The "blinding promise" of SSI is leading to political and organizational myopia in which too many organizations want to get involved and get the credit for establishing schemes – usually and regrettably, only actually building the headworks. Taking credit for establishing such schemes does not seem to be accompanied by a willingness to be "accountable" when there are difficulties. This lack of accountability, borne of an irrational compartmentalization of responsibilities associated with the current institutional approach to SSI, is regrettably, in the view of the PEA Team, leading to institutionalized mediocrity in the performance of the sector. It is the antithesis of the type of selective program integration that will be required for really effective, efficient and sustainable SSI schemes.

Practical Guidance/Tools for Environmentally-Sound SSI

This final chapter of the PEA report presents "guidance" and tools that will enable concerned parties to ensure that environmental concerns regarding small-scale irrigation are taken into account in an effective manner in design, planning, construction and operation of SSI schemes. It reviews a series of scenarios for how environmental review within the framework of Reg. 216 will be applied to SSI in the future in Ethiopia.

The following scenarios and the "guidance" associated with them, are foreseen:

- **Responsibility for Preparation of IEEs:** The preparation of the IEEs will continue to be the responsibility of the Cooperating Sponsors who will submit them to the USAID/Ethiopia Environment Officer.

- **Threshold Decisions:** This PEA has corroborated the principle that in many cases, such activities would, in all probability, qualify for a Threshold Decision of Negative with Conditions. This PEA has identified the "conditions" wherein Cooperating Sponsors could justify such a decision. These "conditions" are presented in the form of an "Environmental Planning Checklist" which specifies the type of information that must be presented as part of the IEE.

- **Environmental Planning Checklist:** In order to use this "Checklist," there is a presumption that the Cooperating Sponsor will have a good deal more information available on the parameters of each site for which SSI is being proposed than has been the case in the past. Data and information required for the checklist will be essential for environmentally sound planning of SSI. It will also engender a greater degree of upfront concern for and understanding of important environmental considerations associated with SSI. It should also lead to improved overall understanding of the social, technical, economic and institutional issues needed for sustainable SSI. Appendix H contains the Environmental Planning Checklist.

- **Amended IEEs:** Cooperating Sponsors would present an "Amended IEE" with the next cycle of DAP/PAA submissions that will review the sites for which a "Negative with Conditions" was specified in the FY 1998 IEE. This Amended IEE will conform to specifications for information required in the Environmental Planning Checklist.

- **Potential for Positive Determinations:** The PEA Team has also indicated where or under what conditions a "Positive Determination" requiring an Environmental Assessment might be necessary. These indications are presented in Section 7.3.

- **The Importance of Monitoring:** In a given SSI site, approved as a case of "Negative with Conditions," it will, nevertheless, be important to be vigilant about the possibilities for unforeseen negative environmental impacts emerging during the construction and implementation stages of the activity. The specifics of a plan to monitor for these impacts will be part of the IEE. Section 7.4 presents a discussion of the important points that must be monitored as an activity goes forward. The expectation is that this "monitoring guidance" will be realistic, performance-oriented and assist the Cooperating Sponsors to ensure that the desired "Intermediate Results" are being achieved in ways that are environmentally benign.

Map of Ethiopia

Acronyms

AFD	African Development Bank
BEO	Bureau Environmental Officer
BHR	Bureau for Humanitarian Response (USAID)
CIDA	Canadian International Development Agency
CO-SAER	Regional Commission for Sustainable Agriculture and Environmental Rehabilitation
CS	Cooperating Sponsor
DAP	Development Activity Proposal
DFID	Department for International Development (formerly ODA- UK)
E.C.	Ethiopian Calendar (6 years earlier than Gregorian Calendar)
EHRS	Ethiopian Highlands Reclamation Study
EIA	Environmental Impact Assessment
EOC	Ethiopian Orthodox Church
EPA	Environmental Protection Authority
ESRDF	Ethiopian Social Rehabilitation and Development Fund
FAO	Food and Agriculture Organization of the United Nations
FDRE	Federal Democratic Republic of Ethiopia
FFW	Food-for-Work
FHI	Family Health International
GNP	Gross National Product
IAR	Institute for Agricultural Research/MOA
IDD	Irrigation Development Division
IEE	Initial Environmental Examination
IFM	Integrated Fertility Management
ILCA	International Livestock Center for Africa

ILRI	International Livestock Research Institute
IPM	Integrated Pest Management
IUCN	International Union for the Conservation of Nature
kms	kilometers
LUPRD	Land-Use Planning and Regulatory Department
MOA	Ministry of Agriculture
MWR	Ministry of Water Resources
NGO	Non-Governmental Organization
PAA	Previously Approved Activities
PEA	Programmatic Environmental Assessment
PVO	Private Voluntary Organization
REDSO/ESA	Regional Economic Development Support Office/East and Southern Africa
REST	Relief Society of Tigray
SCF	Save the Children Fund
SCRP	Soil Conservation Research Project
SNNPR	Southern Nations and Nationalities Peoples Region
SSI	Small-Scale Irrigation
UNDP	United Nations Development Program
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Program
USAID	U.S. Agency for International Development
USCC	U.S. Catholic Conference
WHO	World Health Organization
WRDA	Water Resources Development Authority
WVI	World Vision International
WV/Ethiopia	World Vision/Ethiopia

The Joy of Farming

Photo by T. Catterson

These two farmers – father and son – were excited and proud of their bumper sorghum harvest, made possible by a simple spate irrigation system along a seasonal river near Dire Dawa. All they required was a minimum of assistance to layout an improved canal system on the riverine terrace. The opportunities for spate irrigation are relatively abundant but typically very small in size, owing to the topography along the rivers.

1. Purpose and Need for Small-Scale Irrigation (SSI) in Ethiopia

1.1 General Background on Food Security in Ethiopia

Ethiopia, with a population of 56 million, is the third most populous country in Africa. Most of the population live in the rural areas with only 16 percent living in the cities. Poverty, famine, war and lack of infrastructure in Ethiopia have helped to preserve some of the worst demographics, food insecurity and health conditions in the world. In 1998, the per capita gross national product (GNP) was estimated at $110 with economic growth at 2 percent with 89 percent of the population well below the poverty level as defined by an income of less than $2.00/day.[1] National statistics indicate a mortality rate for children under the age of five at 177/1,000 live births, a total adult literacy rate of 36 percent and primary school enrollment at about 27 percent.[2] Results from the 1992 National Nutritional Survey showed that 64 percent of children between the ages of 6 to 59 months had stunted growth (low height-for-age). Ethiopia has one of the highest rates of population growth in the world at 2.9 percent, a total fertility rate of 7.0 and a national contraceptive prevalence rate of 4 percent.[3] The current population of 56 million is expected to double within the next 23 years.

Ethiopia has a history of recurrent drought and famine. Scarcity of food is a primary cause of the country's high rates of malnutrition and disease. Despite large amounts of food aid which entered the country over the past decade or so, the last National Nutritional Survey showed a worsening picture. The problem has two distinct aspects: acute malnutrition (wasting or low weight-for-age) due to drought and chronic malnutrition (stunted growth or low height-for-age) resulting from poverty related factors occurring in all parts of the country. Although there are regional variations, the data suggest that stunted growth nationwide increased from 59.8 percent in 1983 to 64 percent in 1992. The prevalence rates for underweight for all regions combined increased from 37.3 percent to 46.9 percent.[4] For the period 1988 to 1990, average caloric intake among Ethiopians was 73 percent of recommended daily requirements, one of the lowest in the world.[5] There has been little evidence since then that the overall picture has significantly changed.

1.2 Rationale for SSI

Small-scale irrigation has been chosen by the majority of the Cooperating Sponsors as a strategic intervention to address food security in Ethiopia. (The others CSs are CARE/Ethiopia, Ethiopian Orthodox Church, Food for the Hungry/Ethiopia, Relief Society of Tigray and World Vision International/Ethiopia. Save the Children Fund/USA-Ethiopia does not have SSI activities at this time.) A number of factors led to this choice, the most obvious of which is that irigation increases the potential for producing more food more consistently in the drought-prone food-insecure areas. This remains the central hypothesis for these activities and investments. Another factor favoring the adoption of irrigation was that irrigation was seen as a "window of opportunity" during the mid-1980s, despite decades of traditional efforts at promoting SSI. This had several reasons.

During the former Derg regime, many such schemes were collectivized, leading to poor operations and maintenance and the need for rehabilitation. Similarly, the changing nature of Title II funded activities, shifting along the "Relief to Development Continuum," challenged the Cooperating Sponsors to find new and sustainable means for addressing food insecurity and avoiding dependency problems within food aid recipient communities. There was a realization that the combination of resources available under the program were now better suited to creating productive assets and infrastructure. This fit well with the felt needs of many traditional communities which had small-scale irrigation infrastructure that needed massive annual upkeep because of wash-outs of diversion weirs, siltation and damage

[1] World Bank 1999. **World Development Report**.

[2] UNICEF 1998. **State of the World's Children**.

[3] UNICEF 1998. **State of the World's Children**.

[4] Central Statistical Authority 1993. **Report on the National Rural Nutrition Survey, Core Module**. March 1992. Statistical Bulletin 113.

[5] UNICEF 1998. **State of the World's Children**.

within the canal system from uncontrollable flooding. In fact, these damages were seen to be increasing as the result of the slow but inexorable degradation of upper catchments and watersheds in many areas.

Thus, adding small-scale irrigation to the Cooperating Sponsors food-aided development efforts, many of which were focused on natural resource protection and management, made good sense to both the Cooperating Sponsors and USAID.

1.3 Status and Potential of Small-Scale Irrigation

Getting good statistics on small-scale irrigation, which also includes traditional schemes, is understandably difficult. At present, the figures most frequently cited estimate a total of approximately 65,000 hectares (MWR, 1998; CSA, 1998; AQUASTAT, 1998; IDD/MOA, 1993). These same documents, however, raise the issue of the need for rehabilitation and upgrading many of these schemes. These figures are in sharp contrast to the widely cited overall potential for irrigation throughout the country, including small, medium and large-scale irrigation, which is thought to be possible on 1.8 to 3.4 million hectares, of which anywhere from 180,000 to 400,000 hectares are considered potentially developable as small-scale themes. The following **Table 1.1** provides an overview of present reference data regarding the scope for small-scale irrigation in Ethiopia.

This kind of data and information is particularly important for understanding sector development options and policy; it can be a real constraint if the data is unclear, extremely varied and considered unreliable. This information does, however, serve to put the consideration of small-scale irrigation as a food security strategy into perspective. The present levels of total area estimated to be under SSI is currently less than one percent of the total area currently being farmed. Furthermore, there is a need to know the area of the food insecure regions in the country; what percentage of the existing SSI is within these areas; and what percentage of the projected potential area for small-scale irrigation is within these food insecure woredas. A similar analysis could be carried out on the basis of population and small-scale irrigation users.

Table 1.1: The Potential Area for and Actual Status of Small-Scale Irrigation in Ethiopia

Reference Source	Potential Irrigable Area (hectares)	Actual Irrigated Area (hectares)		Notes/Observations
CSA (1998)	-----	95/96 84,640	96/97 68,210	Meher (main rainy) season
AQUASTAT (1998)	165,000 - 400,000	63,581		An online data base supported by FAO. Raises issue of need for rehabilitation
MWR (1998)	180,000	64,000		Notes that some schemes are not functioning and in need of rehabilitation
Tahal (1998)	-----	40,270		Traditional Schemes only- those without assistance from outside the community
IDD/MOA (1993)	352,000	70,000		Estimate of traditional irrigation without external assistance
FAO (HRDP)	270,000	-----		Potential for SSI using both ground water and surface water sources

Visions of Hope

It is not hard to understand why people and politicians are drawn to small-scale irrigation in Ethiopia. These photographs, taken at the Mai Leba Scheme in Tigray, demonstrate the high visual and emotional impact of a shimmering blue lake in contrast to the dry, seemingly barren surrounding hills. Local people also applaud these efforts, even if they do not have a part in the scheme, because they will be able to find water for their animals, something that can be very difficult to do in the dry season. Is visual impact or better access to water for livestock, however, enough, and at what cost?

2. Background to the PEA

2.1 Introduction and Rationale for the PEA

USAID's environmental regulations (22 CFR 216), commonly known as Reg. 216, establish the conditions and procedures for environmental review of the activities funded with Agency resources. In late 1996, the Agency determined that these regulations needed to be more consistently applied to P.L. 480 (Food for Peace) activities. Although Title II disaster-related activities are permitted exemptions in Reg. 216 and emergency activities were often funded with authority to proceed "not withstanding" various Agency regulations, any other Title II food-assisted activities were always subject to Reg. 216. As Title II funds became increasingly used for development activities, the Agency clarified the applicability of Reg. 216 to food-assisted development and, prior to the end of FY 98, required full compliance with the Agency's environmental procedures. "Of the $821 million of Title II funding in FY 97, $309 million was provided to Cooperating Sponsors to carry out development food aid programs, which support activities in maternal and child health, agricultural production, natural resource management and infrastructure development (e.g., roads, bridges, latrines, wells and small-scale irrigation systems.)" (USAID, 1998)

Accordingly, with support from USAID's Africa Bureau, and in particular staff within the Office of Sustainable Development (AFR/SD/ANRE) and the Regional Environment Officer (REDSO/ESA REO), the Cooperating Sponsors (CS) began a process to respond to this mandate. This effort included the preparation of explanatory documentation regarding the process and procedures and a series of training workshops for USAID and CS staff in Africa. One such workshop was held in Mekelle, Ethiopia in February 1997 at which all FY 97 Title II Cooperating Sponsors were represented. One of the key themes highlighted during the workshop was the explicit recognition that properly designed and executed development activities would achieve greater positive benefits for the participants and would, by definition, be far less likely to lead to negative impacts on the environment. Another issue which arose at all the Africa-based workshops was the question of how to handle irrigation activities being carried out by the Cooperating Sponsors within the framework of Reg. 216.

Among other things, the outcome of this workshop and subsequent discussions between the Agency and the Cooperating Sponsors identified the fact that certain activities typically part of the Title II funded program in Ethiopia would fall within the "class of actions normally having a significant effect on the environment" [216.2(d)]. One of the most notable of these classes of actions, and one shared by the majority of the Cooperating Sponsors in Ethiopia, was "irrigation or water management projects including dams and impoundments" [216.2(d)(ii)] which require a formal Environmental Assessment.

These Title II funded irrigation activities are important both programmatically and in terms of their potential impact on food security in the country. Despite the fact that these actions were typically small in scale, a Positive Threshold Decision for this class of actions would normally be the outcome of the Initial Environmental Examinations being prepared by the Cooperating Sponsors as part of their Development Activities Proposals (DAPs) submitted to USAID Bureau for Humanitarian Response (BHR). In order to allow this important program component to proceed, since a PEA could not have been completed in FY 98, the BEO concurred with recommendations from the Mission and the sponsors that the Initial Environmental Examination would propose a Negative Determination with Conditions for all FY 99 irrigation activities and a Deferral [216.3(a)(iii)] for all such activities in the out-years of the respective DAPs.

The primary condition for these Negative Determinations, beyond the stated mitigation and monitoring measures, as decided by USAID and the Cooperating Sponsors, was to carry out a Programmatic Environmental Assessment (PEA) of small-scale irrigation. It was recognized that the PEA procedure [216.6(d)] would have good applicability to the situation of the USAID Title II Cooperating Sponsors because the mechanism was specifically foreseen "as appropriate to....assess the environmental impacts that are generic or common to a class of Agency actions."

Catholic Relief Services (CRS), after consultation with USAID and the other Cooperating Sponsors working in Ethiopia, agreed to take the lead in carrying out this Programmatic Environmental Assessment of Small-Scale Irrigation, utilizing funding available to it through its USAID-funded Institutional Strengthening Grant (ISG). CRS is convinced that all efforts to improve the design and execution of Title II funded activities should be its primary concern and that this objective is completely in accord with the objectives of its ISG, hence, the decision to take a leadership role in carrying out this PEA. Therefore, following the procedures specified in Reg. 216, the Scoping Statement [216.3(a)(4)] was prepared, subsequently reviewed and approved by USAID, thereby, allowing for the present study to go ahead.

2.2 Purpose of the PEA

This PEA has multiple objectives:

- Facilitate and encourage the identification of environmental issues early in the planning cycle; designing environmental improvements into these activities and thereby avoiding the need to mitigate or compensate for adverse impacts.
- Advance an understanding of the state-of-the-art of sustainable small-scale irrigation, by developing a document that will be useful to USAID and Cooperating Sponsors (and others working with these types of investments) in determining whether or not to proceed with small-scale irrigation development and how to efficiently and effectively plan and manage these activities.
- Build staff capabilities and organizational systems which lead to more sustainable small-scale irrigation systems.
- Facilitate the ability of the Title II Cooperating Sponsors and USAID/Ethiopia to comply with the statutory requirements of Reg. 216 as they apply to their small-scale irrigation activities.

2.3 Description of Scoping Process

As per Reg. 216 procedures, a multidisciplinary team undertook the Scoping Process for this PEA during the period July 27 to August 14. The Scoping Statement was prepared with the on-site assistance of the Regional Environment Officer and a Scoping Team assembled by CRS. This seven person team, including the present PEA Team Leader, carried out an extensive series of consultations with knowledgeable personnel from Ethiopian government agencies, the Cooperating Sponsors, USAID and other donor and non-governmental organizations. In addition, the team compiled and reviewed a series of relevant references on small-scale irrigation and environmental issues in Ethiopia. A one day field visit to a representative small-scale irrigation site was also carried out.

The intent of the Scoping Process was to focus the programmatic environmental assessment on a limited number of environmental issues and to identify these issues through proactive public consultation ensuring that a wide number of stakeholders were interviewed. A

Box 2.1: The Many and Varied Benefits of Irrigated Agriculture

Although this assessment might be construed as only screening SSI for its potential negative environmental impacts, the PEA Team has attempted to maintain a positive perspective, best achieved by recalling the many and varied potential benefits and results of SSI, which include:

- improved local nutrition/food security gains;
- higher standard of living;
- contribution to GNP;
- higher yields per unit of land;
- higher yields per unit of water;
- improved management of scarce natural resources (land and water);
- longer growing seasons;
- resilience against drought;
- reliability of water supply;
- rationale for erosion control and watershed management; and
- rationale for the intensification and modern ization of small-holder agriculture and rural lifestyles.

Source: Tillman, 1981

preliminary draft of the Scoping Statement was circulated to both USAID and the Cooperating Sponsors for revision and comment prior to finalizing it for submission to USAID. On October 1, the Scoping Statement (see **Appendix A** for a full copy of the original PEA Scoping Statement) was submitted for review and approval to the BHR Environment Officer as per the specifications in [216.3(a)(4)(ii)]; approval was received shortly thereafter on 14 October 1998.

2.4 PEA Approach and Methodology

This Programmatic Environmental Assessment of USAID Title II-funded Small-Scale Irrigation activities being carried out by the CSs in Ethiopia was implemented largely as planned during the Scoping Process.

2.4.1 PEA Team Configuration

Catholic Relief Services fielded a seven person multidisciplinary team, including the CRS appointed consultant Team Leader/Environmental Review Specialist, two locally hired consultants (the Irrigation Engineer and the Community/Environmental Health Specialist), a CRS Headquarters staff member as Agronomist/Crop Production Specialist, and three CRS/Ethiopia staff members serving as the Soil and Water Conservation Specialist (and Deputy Team Leader), the Economics/Financial Management Specialist, and the Rural Sociologist/Community Institutions Specialist. In addition, USAID's Regional Environmental Officer based in Nairobi joined the team on two occasions to assist with thinking through some of the procedures, briefing the team, and helping to synthesize the preliminary findings of the field work. A brief biographical sketch of each of the Team members and their respective Scopes of Work may be found in **Appendix B**. The Team worked in-country from 2 November 1998 to 17 December 1998, with subsequent compilation and preparation of the PEA report by the Team Leader taking place during the period 21 December 1998 to 16 January 1999.

2.4.2 Team Building

Because of the somewhat innovative nature of the work – there were no models of a PEA for small-scale irrigation to guide the team and none of the full-time team members had had previous experience with PEAs – a short period of team building was considered essential. Accordingly, during the first week of team work, considerable efforts were devoted to enhancing both the conceptual and operational capabilities of the team to work together in an inter-disciplinary manner that would optimize both its field-based fact finding and subsequent analysis of the schemes that would be visited. Rather than recording the full detail of these team building exercises in the body of this report, **Appendix C** contains a synopsis of the steps undertaken.

Perhaps the most salient feature of this exercise was the need to emphasize the real nature of the PEA – an effort at genuine public consultation, with the personnel of the Cooperating Sponsors and other Government of Ethiopia agencies that were visited, to discern a stakeholder-informed view of the Lessons Learned from small-scale irrigation and its environmental impacts. After the first week of field work, the PEA Team Leader made a presentation to the Directors and senior staff of the Cooperating Sponsors to reiterate the nature of the exercise, to seek their views on both content and methodology, and to further underscore the partnership nature of the PEA and the intention and the need to draw on the Lessons Learned by each organization.[6] Similarly, in order to facilitate the work of the Team, a number of tools and procedures were devised that were intended to increase the effectiveness of the field visits. These too are described in Appendix C. Finally, during this first week of activities, team members were asked to identify and obtain copies of additional literature that they felt would contribute to the PEA process. The List of Additional Pertinent References can be found in **Appendix D**.

2.4.3 General Methodology

The Small-Scale Irrigation PEA Team undertook four weeks of field trips, covering approximately 30 different SSI sites and over 6,500 kilometers in the south, east, northwest and north of the country. **Appendix E** provides a synopsis of the Team's itinerary and schedule. In addition to SSI sites being developed by the Cooperating Sponsors, the Team was also able to visit a number of sites that were being implemented by the various Regional Commissions for Sustainable Agriculture and Environmental Rehabilitation (CO-SAER). These regional organizations have now been given overall

[6] A **PEA Inception Briefing** meeting for the Directors of the Cooperating Sponsors was held at CRS/Ethiopia offices on Friday 13 November 1998. An annotated agenda for the meeting was prepared and distributed to all participants. The Agenda note reviewed: the reasons for the SSI PEA, the meaning of a PEA, its objectives, methodology and plans and expected outcomes.

governmental responsibility for promoting small-scale irrigation using government and other donor funds throughout the country.

Although the purpose of the field visits was to gather first hand data and information on the existing experience with small-scale irrigation in Ethiopia, in every case the Team emphasized the need for "public consultation" with sponsor staff, Regional Government personnel, farmers and other members of adjacent communities as the primary vehicle for data gathering. A list of the persons consulted may be found in **Appendix F**. At the close of each week of visits in a region, the Team took the time to hold a "synthesis meeting" to review the observations and preliminary findings of each team member and further promote the inter-disciplinary nature of its inquiries and analysis. Where possible, staff of the Cooperating Sponsors were invited to join these meetings and participate in the discussions. On the basis of these synthesis meetings, the Team Leader prepared a weekly team memorandum recording the most pertinent issues, observations and preliminary findings that had emerged during the week.

2.4.4 Report Preparation

In order to facilitate overall team reporting, a pragmatic, but necessarily artificial, division of the work of the team was agreed. Three sub-team reporting themes were identified and individual team members were assigned to work together in their preparation. The sub-teams included a "technology-oriented" sub-team which addressed matters related to agronomy, irrigation engineering and soil and water conservation; a "socio-economic and institutions oriented" sub-team which addressed matters of economics, rural sociology and the institutional framework for SSI in Ethiopia; and, a stand alone report on the environmental and human health aspects of SSI. This division of labor also served to help prepare and organize a coherent presentation for a final debriefing on preliminary findings of the Team for presentation to the representatives of the Cooperating Sponsors.[7] These three sub-team reports have been incorporated into the present PEA report.

[7] A **De-Briefing/Presentation of Preliminary Findings** meeting was held for the Directors and staff of the Cooperating Sponsors on Tuesday 15 December 1998 in the USAID/Ethiopia conference room. A De-Briefing cum Agenda Note was prepared and circulated to the Cooperating Sponsors and USAID personnel prior to the meeting.

The Challenge of System Maintenance

Photo by T. Catterson

This primary, lined canal is almost blocked as a result of sediment build-up and grass invasion. Located at a site in the south, it was the one SSI scheme where snails, which may have been the vector for Schistosomiasis, were readily observed during the PEA. Part of the problem was an inadequately designed settling basin upstream of the diversion weir which did not adequately trap the suspended silts and sediments.

Watershed Management is Possible

Photo by T. Catterson

Although the small watershed pictured here serves a potable water supply system (with some small SSI), it is clearly an opportunity for action. Managing it so as to protect and improve the water supply in the years to come will clearly have real costs, but will these actually be substantive when compared with the benefits. A staggered closure system applied here would mean certain foregone grazing benefits but given the condition of the slopes, these would be minimal. The returns – an adequate supply of good quality water – is almost priceless and a very real indicator of local development.

3. Proposed Actions and Alternatives

3.1 Synopsis of Present Title II Activities in SSI by Cooperating Sponsors

The program for which this Programmatic Environmental Assessment (PEA) is being prepared includes the activities of the six Cooperating Sponsors presently using Title II resources for small-scale irrigation in Ethiopia; they are: CARE, Ethiopian Orthodox Church (EOC), Food for the Hungry International (FHI), Relief Society of Tigray (REST), World Vision International (WVI), and Catholic Relief Services (CRS). The CRS program in small-scale irrigation is being implemented in cooperation with two of its primary counterparts: Adigrat Catholic Secretariat (ADCS) and the Hararge Catholic Secretariat (HCS). At present, Save the Children Foundation (SCF/US) and Africare are also utilizing Title II resources but are not presently including small-scale irrigation in their DAPs.

Operationally, these activities are both simple arrangements with the communities and similar among all the Cooperating Sponsors. The potential for SSI is identified by CS field staff sometimes directly with client communities within the target woredas and sometimes through other contacts such as the Regional Bureau of Agriculture staff. After initial contact with the community and preliminary studies and confirmations that SSI is feasible, the CS field staff undertake a series of meetings with the community or with the water users. Agreement is reached on the broad outline of the SSI scheme and a more intensive planning of the scheme, including water resources engineering design plans, are undertaken.

The community agrees to provide the unskilled labor and local materials (sand, stone, wood) needed to construct the basic infrastructure (weir, dam, primary canals, etc.). They are compensated for their labor by the CS with food-for-work rations so as to ensure food security among participating households. In many cases, and because of chronic food insecurity, the better part of the community will turn out to contribute to these efforts which may only benefit a smaller sub-group of users within the community. All other costs and needs for building the system are normally provided on a grant basis by the concerned Cooperating Sponsor. They use local currency resources, generated through the monetization of Title II commodities, to pay for external inputs (cement, valves, piping, etc.) and to hire skilled masons. For the most part, SSI construction in Ethiopia is labor-intensive with only the occasional use of machinery (funded by the CSs) for the larger diversion and storage dam sites.

Construction may take one or more years, depending on the size of the scheme and the availability of labor. The water users, formed into a water user association, are expected to take the responsibility for organizing themselves within the command area and laying out and building the secondary and tertiary canals (albeit with technical assistance in surveying and hydraulic engineering). Once the main headworks and primary canal are built, the scheme is handed over to the water user association and the Regional Bureau of Agriculture. Development Agents, provided by the Regional Bureau of Agriculture, are expected to assist farmers in developing the practical measures for the utilization of the scheme.

The projected program activities in small-scale irrigation, by type, year and Cooperating Sponsor, as summarized from their respective DAPs and IEEs, is presented in the **Table 3.1**.

3.2 A Typology of Small-Scale Irrigation Systems in Ethiopia

In Ethiopia, small-scale irrigation (Ethiopian definition) is considered to be any system that supplies a total command area of under 200 hectares (as opposed to medium-scale: 200 to 3000 hectares and large-scale: 3000 hectares and above). None of the present small-scale irrigation activities being undertaken by the Cooperating Sponsors with Title II resources, with one exception, and as currently described in the IEEs, will exceed 200 hectares.[8]

The typology presented here is based on water source

[8] The site in question, over 200 hectares, is the CARE site at Doni; it could actually be viewed as two separate schemes, given the way it was constructed.

13

and on distribution technology. It is also important to stress the fact that the type of SSI systems to be applied is, by definition, site specific; for example, it would not be effective to use a diversion type system where, given the site and water availability characteristics, a storage system is needed. These different types are not interchangeable.

Diversion systems

Often referred to as off-take systems, diversion systems are probably the most common form of irrigation system in Ethiopia. Diversion systems often utilize natural river flow, however, regulation of river flow via a permanent structure in the river bed is also a common practice to increase the off-take. Diversion systems abstract water over a sustained period of time and are able to deliver regular irrigation throughout the cropping regime. A key characteristic of diversion systems is the adequacy of water supply during the dry seasons and the ability to irrigate a dry season crop in addition to providing supplemental irrigation during the rainy seasons.

Spate systems

Spate systems make use of occasional flood flows of ephemeral streams and, therefore, operate intermittently during part of the year. In Ethiopia, there are two types of spate systems. The first, often referred to as a run-off system, diverts run-off from rainfall received in the same catchment from natural waterways on to agriculture land. The second, most common on foothill sites in arid and semiarid areas, divert flood flows originating in highland areas. Spate systems have proven difficult to rehabilitate due to the difficulty of designing weirs to divert flows that change dramatically over a short period of time and which also resist structural damage from flood flows.

Spring systems

These systems exploit flows from small springs. Water is often shared with household and livestock users. Water is often stored over night in small reservoirs (night storage) and emptied daily.

Storage systems

These systems, referred to as tanks in South Asia and earthen dams in Ethiopia, store water for an extended period behind dams. In Ethiopia, storage systems are a recent introduction and pose technical and production challenges. It is important to consider the catchment flow and amount of sediment in designing storage systems. Cropping must be planned according to the amount of water stored and available for irrigation. Typically the irrigable area is much larger during the rainy season than during the dry season.

Box 3.1: USAID/Ethiopia's Strategic Plan and the Place of Small-Scale Irrigation

Small-scale irrigation clearly falls within the program actions expected to be responsive to the **Special Objective 1–Enhanced Household Food Security in Target Areas**, and the following Intermediate Results and their indicators:

IR.1: Increased Agricultural Production

- increase in yield by crop
- percent change in overall crop production per household;

IR.2: Increased Household Income

- improvements in the physical state of the household
- increase in income from cash crops
- average number of meals/day

Small-scale irrigation could also have positive impacts related to the achievement of two other intermediate results and their indicators:

IR.3: Improved Health Status of Target Households

IR.4: Natural Resource Base Maintained

Lift systems

Lift systems extract water from rivers, irrigation canals, reservoirs and wells. Lift systems have lower development costs, but usually have higher operating costs. Pumps can be manual or motorized.

3.3 Alternatives to Proposed Actions

In order to fully and clearly understand the issue of alternatives to **the proposed action – the design, construction and implementation of small-scale irrigation** – it is important to clearly state the context under which it is being considered. There are a number of parameters to this context including: the nature of the program, its objectives, the resources available for program execution, and the institutional capabilities for utilizing these resources in an effective and efficient manner.

14

Table 3.1: Synopsis of Small-Scale Irrigation Activities by Cooperating Sponsor

Cooperating Sponsor Program	Spring Systems			Diversion Systems			Spate Systems			Storage Systems			Lift Systems		
	No. of Sites	Total Area	No. of HHs*	No. of Sites	Total Area	No. of HHs	No. of Sites	Total Area	No. of HHs	No. of Sites	Total Area	No. of HHs	No. of Sites	Total Area	No. of HHs
CARE Ethiopia DAP Food and Livelihood Security Program (FY 1997- FY 2001)															
FY 99	9	NA	NA	1	200	200	3	NA	NA	1	NA	NA			
Out-Years															
Catholic Relief Services Ethiopia DAP (FY 1997 - FY 2001)															
FY 99					2	18	375	25	104	167					
Out-Years		6	36.3	755				25	115	529					
Ethiopian Orthodox Church Development and Inter-Church Aid Commission (EOC-DIDAC) DAP (FY 1998 - 2003)															
FY 99					6	95	405								
Out-Years					20	211	734								
Food for the Hungry International Development Project (FY 1999 - FY 2001)															
FY 99	2	11	81		6	NA	NA								
Out-Years					8	NA	NA								
Relief Society of Tigray Integrated Food Security Program (FY 1999 - FY 2003)															
FY 99					2	130	650								
Out-Years					15	60	4,080								
World Vision International Development Activity Proposal (FY1998 - FY 2002)															
FY 99					1	20	100								
Out-Years															

Note: Data for outyears was not consistently supplied in the Cooperating Sponsors' IEEs. Thus the absence of entries in the outyears' rows merely reflects lack of data.

* HH=-households

15

Furthermore, as mentioned above, the question of alternatives is not related to the choice of SSI technology types that might be applied in a given situation. The type of SSI technology is almost always site specific, especially considering the efficiency parameter. Rather the consideration of alternatives relates to the choices in achieving the desired end result – improved food security – with the resources and capabilities available to program practitioners, in this case, the Title II-funded Cooperating Sponsors.

Although the Cooperating Sponsors are free to supplement their activities and investments with non-program resources, and most do so, the program-funded small-scale irrigation activities being considered in this assessment are principally those made possible by the utilization of the Title II-Food for Peace program resources granted to them by USAID under their DAPs. The objective of that program – Special Objective No. 1 of USAID/Ethiopia's Strategic Plan – is "Enhanced Household Food Security in Target Areas." The resources made available to each Cooperating Sponsor consist of food aid commodities available for food-for-work, local currency generated by monetization of food commodities (mainly vegetable oils), and Section 202.e dollar funds that accompany each DAP agreement. The present agreement between the Government of Ethiopia and USAID also dictate certain elements that direct the nature of the program and its alternatives; these elements include: the geographic choice of target areas, i.e., the predetermined food insecure woredas of the country; a limitation on the number of expatriate staff that a CS may employ in-country; and the nature of the relationship, roles and responsibilities between the CS and the regional governmental agencies. And finally, the choice of small-scale irrigation as an alternative strategy option for achieving the results related to improved household food security must be considered in the light of the institutional capabilities of the Cooperating Sponsors – the skills, training and experience of the organization and its staff, and the needs, commitment and support from the target communities.

3.3.1 No Action Alternative

Any environmental assessment requires the consideration of the no action alternative [22 CFR 216.6(c)(3)]. Sometimes referred to as the "no build or do nothing alternative," it implies that the proposed actions do not happen. Although one might presume that with the no action alternative, a maintenance of the status quo would be the result, this is unlikely to be the case. In fact, the no action alternative in this particular instance would be significant in both environmental and socio-economic terms. A failure to address the persistence of food insecurity in these target areas would in all certainty lead to a continuing downward spiral of the people and their environment.

Left to their own devices, rural people in the drought-prone areas of Ethiopia have little recourse but to continue to exploit the natural resource base in unsustainable ways in pursuit of their day-to-day survival. This is clearly an unacceptable outcome. Furthermore, it is manifestly obvious that as people become increasingly more impoverished and their environment more degraded, the eventual costs of rehabilitation and attainment of social well-being increase exponentially. A "no action" posture cannot be contemplated.

3.3.2 Alternative Food Security Strategy Options

There is a relatively wide array of alternatives for achieving the strategic objective of enhanced household food security. This array includes:

- direct feeding programs;
- promoting improved rainfed farming and livestock husbandry; or
- directing rural people to adopt off-farm, alternative income generation activities.

The first and the last of these alternatives assume sufficient supplies of food available in-country, meaning either a continuation of food aid programs or reliance on exports to generate the foreign currency necessary to buy and import food from the international marketplace. Neither of these two are entirely acceptable alternatives.

Most Cooperating Sponsors are already pursuing a wide range of options in the areas in which they have chosen to work. **Not all alternatives, however, are applicable everywhere**, nor would they be as effective and efficient in realizing the gains in agricultural productivity that will be required if Ethiopia is to feed its people in the years to come. The conceptual premises of this PEA highlight the need for considering effectiveness and efficiency as a basis for deciding if small-scale irrigation is the best choice, in a given site, in utilizing the development resources being made available through the Title II program. As the section which follows demonstrates, there is neither scope nor purpose in second-guessing

16

the decision-making already part of the strategic planning which USAID and its Cooperating Sponsors have already carried out as the basis for these programs. The real choices can only be made on a site by site, geographic or livelihood basis. The consideration of the environmental impacts of small-scale irrigation clearly can and should be a factor in the decisions-making process.

3.3.3 Preferred Alternative

The preferred action implicit to this PEA is the promotion, development and implementation of small-scale irrigation. It should, however, be carefully pointed out that **the "preferred alternative" in this case is neither**, nor can it be:

- **a choice between either types of SSI technology** (spate, spring, storage, diversion, or lift systems); or
- **a choice between strategy options** related to achieving the program strategic objective of "enhanced household food security" (feeding programs, improved rainfed agriculture, off-farm alternative income generation).

Such comparisons and choices are, and can only be, site or area specific. Typically, only one type of irrigation system is appropriate to the site conditions (conditions being understood to include both the bio-physical and socio-economic conditions).

Comparing the alternatives for achieving enhanced household food security is, on the other hand, well beyond the scope of the present exercise. However, and it is important to be clear on this point, the choice of small-scale irrigation as the "preferred alternative" presumes that the basic feasibility analyses have been part of the program planning process. More specifically, the assumption is that the Cooperating Sponsors have analyzed the feasibility – technical, social, economic and institutional – of the proposed scheme and concluded that it is an effective and efficient means, compared with other alternatives, for achieving results related to enhanced household food security. It may not be, and in fact rarely is, the only alternative within a given area for achieving such gains, as is amply demonstrated by the multi-faceted programs typical of Title II funded programs in a given area.

Although these somewhat nuanced distinctions and discussions may appear to be an over-sophistication within the context, purpose and intent of this PEA, they do have merit. They underscore again the importance of the analysis of feasibility issues to be discussed in Chapter 6, which addresses the overall sustainability of small-scale irrigation and the PEA Team's observations in that regard.

17

Irrigation Makes Agricultural Intensification Possible

Photos by T. Catterson

Farmers prepare a field for sowing in anticipation of abundant water within this diversion scheme in the south. This farmer has his own oxen but other farmers pointed out that limited animal traction made it difficult for them to take full advantage of the SSI investment. Based on the sclerotic look of this maize crop, fertilizers were missing too.

18

Doing Things Right

The Agbe River Diversion Scheme in Tigray is a well-built canal with drop structures,controlled gates and cross-drain structures. At present, farmers are using only a small portion of this upper section of the command area to irrigate a nursery of chili plants (light green cross-hatched area near people in upper left). Most of the upper section is currently in fallow. Unfortunatly, the woman in the foreground is using the canal to wash her clothes and collect water for family use.

19

4. Policy and Institutional Framework for SSI in Ethiopia

4.1 The National Irrigation Policy Framework

Irrigated agriculture – in the form of spate systems capturing the run-off from the Ethiopian highlands along the Red Sea Coast has been a land-use choice in the Horn of Africa for more than a thousand years. These early schemes were the precursors to the small-scale, traditional irrigation schemes, including spate, diversion and very small storage systems, now widely practiced under local community arrangements throughout the country.

Indeed, the development of the country's irrigation potential is an important part of a "major program for the intensification of agriculture" launched by the new Federal Government (EPA, 1997). As part of this effort, a draft Water Resources Policy to guide water sector development into the next century is presently being circulated among the concerned ministries and agencies for review and comment and as the basis for wide ranging consultative meetings, both at the center and in the regions.

The three volume draft of the Federal Water Resources Policy represents a new thrust for a comprehensive and integrated approach to water resources management that is expected to guide sector development into the new century and within the framework of the new federalist system of government. The stated goal of this policy is:

> to enhance and contribute its share in all national efforts towards the attainment of a prosperous, healthy and socio-economically developed society with all its human dignity by promoting sustainable management of water resources of the country, without endangering and compromising the capacity of water resources base for regeneration in the services of future generations. (MWR, 1998)

More specifically, the objectives of the policy underscore, *inter alia*, the need for the development, conservation and enhancement, provision of basic necessities, and the allocation and apportionment of water. These objectives are based on comprehensive and integrated plans and principles that incorporate efficiency of use, equity of access and sustainability of the resources. The policy objectives are also specifically expected to ensure that environmental protection measures are taken into account "in the course of studies, planning and implementation and operation of water resources and water resources systems." (MWR, 1998)

The policy papers provide a fairly forthright and courageous account of the performance of "the water sector in Ethiopia" and the continuing problems it faces "from lack of clear objectives, policy directives and coherent plans." It also draws attention to **"the frequent reorganization of water sector institutions with its inevitable migration of professionals, loss of documentation and information, discontinuity of projects and operations and the fragmented management...that have proved to be disastrous to the water sector."**

These concerns and the enlightened new directions about the sustainability of water resources development mirror a growing parallel within the country for environmental planning and review. It is worth noting that

Box 4.1: Problems of the Water Sector in Ethiopia

- General uncertainties and ambiguities on planning
- Non-objective oriented programs and projects
- Ambitious planning divorced from actual existing conditions and capacities
- Delays
- Cost overruns
- Non-sustainable systems
- Systems bogged down by poor operation and maintenance practices
- Ad hoc development practices lacking coherent objectives and continuity.

Source: MWR, 1998

21

during its consultations, the PEA Team was apprised of a number of initiatives aimed at further developing the processes and capabilities for environmental review in Ethiopia. The Government's Environmental Protection Authority (EPA) has now published an "Environmental Impact Assessment Guideline" along with a series of sector-specific guidelines, including one devoted to agricultural sector development projects (EPA, 1997a). The EPA anticipates that these guidelines will soon be officialized through their publication as governmental regulations. Similarly, the Ethiopian Social Rehabilitation and Development Fund (ESRDF), part of a program funded by the World Bank, has also published an "Environmental Checklist" as a companion piece to its multi-volume project appraisal guidelines (ESRDF, n.d.). And lastly, Lutheran World Federation has recently prepared environmental review guidance and has initiated a year long study to incorporate environmental review into project planning.

4.2 Environment Policy in Ethiopia

The first comprehensive statement of environmental policy for the Federal Democratic Republic of Ethiopia was approved by the Council of Ministers in April 1997. (EPA, 1997) It was based on the policy and strategy findings and recommendations contained in Volume II of the Conservation Strategy for Ethiopia. Like the Water Resource Policy, the environment policy is predicated on a growing concern for the degradation of the natural resources base and how that base affects and is affected by the overall productivity of the agriculture sector in the country. The "overall policy goal is to improve and enhance the health and quality of life of all Ethiopians and to promote sustainable social and economic development through the sound management and use of natural, human-made and cultural resources and the environment as a whole so as to meet the needs of the present generation without compromising the ability of future generations to meet their own needs." (EPA, 1997)

This overall policy statement is intended to parallel the present effort to develop a coherent macro-economic policy and strategy framework for the new federal approach to government and development. It is expected that it will serve to guide the eventual comprehensive formulation of cross-sectoral and sectoral policies and "to harmonize these broad directions and guide the sustainable development, use and management of the natural resources and the environment." (EPA, 1997). The Box 4.2 provides extracts from the respective policy objective statements within the National Environment Policy that are relevant for the present consideration of small-scale irrigation and environmental review.

Box 4.2: Extracts from the Environment Policy of Ethiopia

- Incorporate the full economic, social and environmental costs and benefits of natural resources development;
- Appropriate and affordable technologies, which use renewable resources efficiently, shall be adopted, adapted, developed and disseminated;
- When a compromise between short-term economic growth and long-term environmental protection is necessary, then development activities shall minimize degrading and polluting impacts on ecological and life support systems;
- Regular and accurate assessment and monitoring of environmental conditions shall be undertaken;
- To base, where possible, increased agricultural production on sustainably improving and intensifying existing farming systems by developing and disseminating technologies which are biologically stable, appropriate under prevailing environmental and socio-economic conditions for farmers, economically viable and environmentally beneficial;
- To ensure that planning for agricultural development incorporates in its economic cost-benefit analysis, the potential costs of soil degradation through erosion and salinization.;
- To promote in drought-prone and low rainfall areas, water conservation; and
- To ensure that agricultural research and extension have a stronger focus on farming and land-use systems and support an immediate strengthening of effective traditional land management systems.

The Federal Government has also embarked on the establishment of a system of environmental review as a prerequisite for the approval of new development activities and projects. Although the overall system has yet to receive full operational approval, the Environmental Protection Authority has issued a series of guidelines,

22

including Procedural Guidelines and Sectoral Guidelines (EPA, 1997a). To this end, the EPA has published EIA Sectoral Guideline–Volume II: EIA Guideline for Agricultural Sector Development Projects (EPA, 1997b). Section 2.3 of that guideline specifically targets Irrigation and Drainage Projects and suggests a range of issues and sub-issues that should be considered in assessing these types of projects. The list of key issues includes: hydrological impacts, water and air quality, soil properties and the effects of soil salinity, and erosion and sedimentation. Responsibility for the assessment of the environmental impacts of medium and large-scale irrigation projects will require a "full Environmental Impact Statement" that will be submitted to the EPA for review and approval. **The review and screening of small-scale irrigation will be done by an as yet un-named competent agency" at the regional level**. (EPA, 1997a)

It is also noteworthy that the UN Economic Commission for Africa and the UNDP-sponsored Sustainable Agriculture and Environmental Rehabilitation (SAER) Program and the World Bank-funded Ethiopian Social Rehabilitation and Development Fund (ESRDF) – which are now responsible for funding small-scale irrigation activities throughout the country – have recently developed environmental impact assessment guidelines for their operations. In fact, the latter has published a large, four volume guide to the planning and execution of small-scale irrigation which provides highly technical and comprehensive insights into all facets of scheme planning, design, construction and operation.

4.3 Institutional Framework for the Development of Small-Scale Irrigation

Modern irrigation got its start in Ethiopia as a result of private investment, some of which was funded by foreign investors, particularly in the middle Awash Valley. (AQUASTAT, 1998) All large-scale irrigation was nationalized in 1975 by the Derg Government which handed them over to the Ministry of State Farms. Small-scale irrigation suffered a similar fate and most landlord-based SSI were converted into Producer Cooperatives and new schemes also built, albeit with very mixed results because of resistance to collective farming. A distinction in responsibilities for large and medium versus small-scale irrigation has been in place for some time; the Water Resources Development Authority (WRDA) of the Ministry of Water Resources continues to this day to take the lead in large and medium-scale irrigation development.

Renewed government interest in promoting farmer and community-oriented small-scale irrigation, by providing assistance and support to local communities for rehabilitating and/or upgrading traditional schemes, began in the early 1980s. (Habtamu, 1990) After the major famines of that period, which evidenced the importance of building additional crop productivity capabilities at the local level, the government began to focus on the potential of small-scale irrigation as a food security option.

Beginning in 1985, the Irrigation Development Department (IDD) of the Ministry of Agriculture (MOA) was charged with the development of SSI activities and providing assistance to farmers and communities. Their efforts were eventually decentralized to the zonal level where Irrigation and Rural Water Supply Teams were established to foster and facilitate the expansion of SSI at the local level. It is noteworthy that SSI development was traditionally seen as "infrastructure" development, and grouped with rural roads and similar construction teams and largely staffed with "engineering" oriented personnel. Fully 75 percent of the staff of the IDD, as described by Habtamu in 1990, were of the engineering cadre. Under the IDD, the typical Irrigation and Rural Water Supply Team was comprised of three brigades: earthen dam construction, diversion weir construction and land development. The department struggled over the years with less than optimal, centralized funding and staffing limitations to meet the challenges and opportunities of SSI development across the immense territory of the Ethiopian highlands.

In 1994, with the change in government and the recognition of the continuing need for greater regional autonomy and realistic decentralization, the IDD was dissolved. Government policy support for small-scale irrigation, however, remains high; the importance of SSI to the government was perhaps best manifest in the creation of the Regional Commission for Sustainable Agriculture and Environmental Rehabilitation (CO-SAERs) now being promoted under the new federalist structure in a number of regions. These new organizations have embraced the promotion of small-scale irrigation as their primary mandate and they are channeling millions of Ethiopian Birr each year into such development and construction activities.[9] The focus within these organizations and the overall approach remains rather engineering-oriented, a feature that permeates the approach to SSI even within the activities of the Cooperating Sponsors.

9 The exchange rate in the last few years has been from Ethiopian Birr 5 to 6.7 to the US $1.

23

The present development strategy and its corresponding institutional model encompasses three phases and a changing cast of institutional players. At the design phase, a combination of regional bodies – the Regional Bureaus for Agriculture, Energy, Water and Mining, and Health, together with the project proponent, whether one of the Cooperating Sponsors or the CO-SAERs – work together on the design and siting requirements of a prospective scheme. Once the basic project document is approved, the CO-SAERs or the Cooperating Sponsors take charge and work with the community and the concerned Woreda Council, in the construction of the basic infrastructure (headworks – dam or weir and primary canals).

Once these civil works are completed, the scheme is handed over to the communities concerned and the Regional Bureaus (Agriculture, Energy, Water and Mining, and Health[10]) for the implementation of the irrigation system itself. The community is expected to complete the secondary and tertiary canals and begin to use the system, with the advice and assistance of the Development Agents provided by the Regional Bureau of Agriculture through a Water Users Association created among the user community. The other two bureaus – Water, Energy and Mining and Health – are expected respectively to ensure that the head works are properly maintained and/or the health concerns, if any, are addressed.

4.4 Small-Scale Irrigation and USAID's Strategic Plan

Although the food situation in Ethiopia has improved in recent years, it is expected that the country and her people may "remain vulnerable to drought and food shortages for years to come. Even with good harvests in these 'normal times,' both acute and chronic hunger and malnutrition occur among many Ethiopians." (USAID, 1998) For these reasons, the USAID Strategic Plan includes a Special Objective (SPO 1): Enhanced Household Food Security in Target Areas, thereby contributing to the U.S. Government's Mission Performance Plan for Ethiopia of "Providing Humanitarian Assistance."

At present, the ongoing activities of the eight Title II Cooperating Sponsors constitutes the principal mechanism for implementing the program assistance foreseen under this Special Objective. Indeed, the SPO itself was developed in collaboration with the Cooperating Sponsors who all have a long history of humanitarian relief and commitment to the country. The SPO identified five critical intermediate results (IRs): Increased Agricultural Production, Increased Household Income, Improved Health Status, Maintaining the Natural Resource Base and Maintaining Emergency Response Capacity.

Although this PEA on small-scale irrigation has its origins in the Reg. 216 requirements, the Scoping Team believes that its focus also fits the performance based criterion adopted by USAID as its primary measure for continued support to program activities. This PEA is being designed with the objective of viewing small-scale irrigation from a broader perspective and with a focus on results and not just on the completion of planned activities. By its very nature a programmatic assessment is results-oriented. While irrigation is mainly seen as one of the activities contributing to the realization of IR1- Increased Agricultural Production, this PEA will demonstrate that sound design and effective implementation will not only avoid negative environmental impacts but also contribute to the achievement of other intermediate results of SPO 1- Enhanced Household Food Security in Target Areas.

For example, small-scale irrigation makes it possible to diversify crop production and capture the opportunities for the production of fruits and vegetables within the expanding market economy. The sale of these crops responds directly to IR 2, Increased Household Income. Likewise, good small-scale irrigation will take into account and plan for the control of disease vectors and water-borne diseases commonly associated with these schemes, thus contributing to IR 3, Improved Health Status of Target Households. Finally, one of the basic premises of the development of small-scale irrigation is to curtail the need of rural people to crop marginal lands and further degrade the natural resource base through erosion and soil depletion. This will contribute to the achievement of IR 4, Natural Resource Based Maintained.

[10] Although the Ministry of Health may not actually be involved during the handover of a given scheme to the community, they would be expected to become involved should a health related issue emerge in the course of operations.

24

Pools of Stagnant Water

Photos by T. Catterson

In the upper photo, puddles below the dam site are the result of leakage filling in the borrow pits excavated for dam fill. Fortunately, because of the high elevation, there is little risk of malaria. The lower photo, which is at a low elevation, shows how the diversion of water from the river has reduced it to a series of stagnant pools making it an ideal breeding ground for mosquitos.

25

Another Example of Canal Maintenance Problems

Photo by T. Catterson

In a good rainfall year, the amount of vegetation build-up in the canal system can be substantial. The unlined canal running from lower left to upper center in this photo has almost disappeared. The farmer whose irrigated plot is adjacent (on the slope below left) has not cleaned his portion of the main canal although others further down the system have already done so. Plowing close to the edge of the canal on the upper side right has contributed to the siltation in the system.

26

5. Environmental Consequences of Small-Scale Irrigation

5.1 Impact Analysis Framework

In carrying out this PEA of small-scale irrigation in Ethiopia, the Team adopted a rather broad analytical framework. (See the list of issues identified in the PEA Scoping Statement.) This focused list of issues was drawn from a variety of sources: a literature review including general documents on irrigation and environmental impacts; Ethiopia-specific references; a series of semi-structured interviews, including a questionnaire about likely impacts, with organizations and individuals with experience in the field; and the Team's own knowledge of SSI and environmental concerns gleaned from previous field visits throughout the country.

Among the most pertinent of the references related to SSI and environmental impacts examined by the Team are:

- *Environmental Screening of NGO Development Projects–Small Dams/Reservoirs* (Canadian Council for International Cooperation, n.d.);
- *Landscapes and Livelihoods: Environmental and Socio-Economic Dimensions of Small-Scale Irrigation* (Guijt and Thompson, 1994);
- *Handbook on Environmental Assessment of Non-Governmental Organizations and Institutions Programs and Projects* (CIDA, 1997);
- *Environmental Guidelines for Small-Scale Activities in Africa–Environmentally Sound Design for Planning and Implementing Humanitarian and Development Activities* (USAID, 1996);
- *Environmental Guidelines for Irrigation* (Tillman, 1981); and
- *Environmental Guidelines for Selected Agricultural and Natural Resources Development Projects* (Asian Development Bank, 1991).

These documents would provide the interested reader or analyst with more than ample guidance for an environmental assessment of small-scale irrigation.

Although the PEA Team found these guidelines to provide useful insights related to small-scale irrigation and environmental impacts, none of them seemed completely suitable for application in the case of these Title II programs. In part, this would appear to be due to the fact that many of these guidelines (and indeed USAID's Reg. 216) were conceived with the issues of large-scale irrigation projects in mind. Similarly, they seem most applicable to cases of new schemes being set up in areas which either have not been alienated for agricultural purposes or which harbor much lower levels of demographic pressure. This contrasts significantly with the current trends for the development of SSI in the Ethiopian highlands which feature rehabilitation of older schemes, typically in heavily populated and often extremely altered and often degraded natural landscape settings.

5.2 Affected Environment

The "affected environment" pertinent to small-scale irrigation in Ethiopia encompasses a wide range of geographic settings, hydrological characteristics, agro-climatic/agro-ecological zones, topographic situations, cultures and socio-economic conditions. Title II Cooperating Sponsors currently promote development, upgrading and rehabilitation of small-scale irrigation schemes in the Southern, Oromia, Amhara and Tigray Regions, based on diversions of streams and rivers, spate flows of seasonal rivers, use of springs, and construction of storage reservoirs. Most of the present activities take place in three of the recognized agro-climatic belts of the Ethiopian highlands, namely, the Kolla belt (500 to 1,500 masl), the Weyna Dega belt (1,500 to 2,300 masl) and the Dega belt (2,300 to 3,200 masl).[11] In the future, Cooperating Sponsors may choose to promote small-scale irrigation in additional locations with different environmental (including cultural and socio-economic) characteristics.

[11] At present, the Ethiopian highlands are divided into nine agro-climatic zones, distinguished by the range of altitudes and annual rainfall. For a full description of the agro-climatic zonation of the country refer to Hurni, H., **Guidelines for Development Agents on Soil Conservation in Ethiopia**. Community Forests and Soil Conservation Development Department, Ministry of Agriculture, Addis Ababa. pp. 100, 1986.

This PEA cannot purport to describe the affected environment for small-scale irrigation interventions in current and future locations. To attempt to do so would be spurious and misleading. The planning, design and assessment of each irrigation scheme must be considered according to its specific site characteristics. Readers seeking an overview of natural resources and socio-cultural characteristics and reference to additional source materials should consult the *Conservation Strategy of Ethiopia* (Environment Protection Authority and Ministry of Economic Development and Cooperation, 1997) and the *Ethiopian Forestry Action Program* (EFAP Secretariat, Ministry of Natural Resources Development and Environmental Protection, 1994) as well as other information listed in the List of Pertinent References of this PEA.

Fieldwork conducted for this study did, however, reveal **common and recurrent concerns and problems, considered typical of small-scale irrigation** carried out by Title II Cooperating Sponsors (and others). The field observations supplemented by literature review and extensive public consultation with a wide range of stakeholders have been organized thematically in the section which follows and the next chapter to provide the basis for a diagnostic of the principal environmental issues and an examination of the impacts that need to be avoided or otherwise mitigated in the planning and design of small-scale irrigation. These issues, which both affect the sustainability of the schemes and/or engender adverse environmental impacts, are considered to be the key issues that should be taken into account in making future investments in the sub-sector. The analysis in these sections will, in some cases, contradict the conventional wisdom of environmental assessment-irrigation literature. The PEA Team has noted that conventional concerns related to SSI and environmental impacts in the literature is often unrealistic for the Ethiopian context, in its diagnosis of problems and presumptions about avoiding or diminishing environmental impacts.

5.3 Environmental Issues Identified during the PEA

The following environmental issues (see **Table 5.4** for a synopsis of the Environmental Impacts of Small-Scale Irrigation–Ethiopia), some of which have multiple dimensions, will generally be discussed in terms of the following: an issue statement, including its causality, a discussion of the implications and the relationship with other environmental issues and with the sustainability of SSI; the stage at which it occurs; detection and monitoring; and suggested mitigation measures.

5.3.1 Inefficient Use of Water

The basic premise of these programs is that SSI can be utilized to increase agricultural productivity substantially in the erratic rainfall and drought-prone areas of the Ethiopian highlands thereby helping to alleviate household food insecurity. It is well-known in Ethiopia that even in relatively good rainfall years, there can be pockets of land that do not get sufficient precipitation to see a crop through to full production. Similarly, where run-off can be diverted or stored and used during the dry season, agricultural production benefits can be significant. Capturing floods for spate irrigation, diverting run-off from perennial streams and rivers, or storing run-off of an otherwise seasonal stream or river represent a significant opportunity to use this precious resource for human benefits and to have a positive impact on the human environment by optimizing the use of this precious renewable resource – water.

Issue and Implications Statement

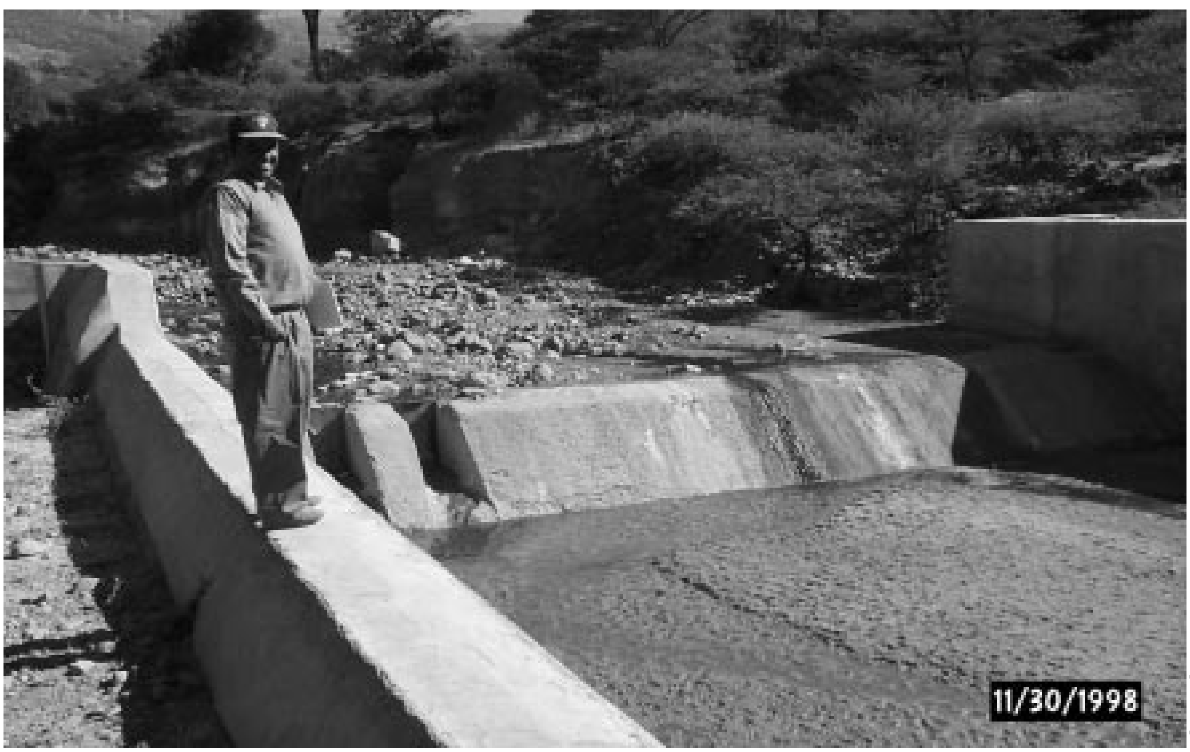
Sub-optimal use of limited surface water run-off being channeled into small-scale irrigation schemes was observed on numerous occasions within the series of sites visited. There were two main reasons for this inefficient use of water:

- **Leakage** from unlined canals, through the earthen dam structure or from breakages in the canal system; and
- **Faulty use of irrigation water** – overwatering in flood irrigation regimes.

Water lost to the system has a number of serious implications and is typically a classical dilemma of irrigation technology. Presuming a reasonable match of available water to crop water requirements and total command areas, water losses will lead to diminished production increases because there will not be enough water to irrigate the full planned command area. Overwatering – using more water than is required for satisfactory crop production – can cause the same effect, exacerbating the challenge of meeting the needs of both “head and tail-enders” within the irrigated perimeter. It may also lead to inefficient use of fertilizers and over-leaching of soils or increasing the proper conditions for pests, thereby reducing the productivity of the cropping system and leaving the soils in a more degraded condition.

Furthermore, water leakage and overwatering can lead

How Much Diversion is Too Much?



Photos by T. Catterson

These two photos, from the same scheme, amply demonstrate the fact that very little water is escaping diversion. Project proponents argue – legitimately – that this river often dries up in the dry season and therefore there is little ecological impact. Until more studies on sensitive ecosystems and endangered species have been carried out in Ethiopia, it would be difficult to argue otherwise. Hypothetically, biodiversity losses are not valid arguments without the studies to document them. The river actually joins another about 1.5 kilometers below the diversion weir and there are no other users along that section.

to localized water-logging and/or salinization of the crop soils. Water leaking out of canals and below dams can also give rise to pools of stagnant water that provide breeding areas for water related disease vectors. Inefficient use of water can become particularly acute during a dry season irrigation regime if water availability declines because of poor rainfall in the catchment area and diminished run-off or due to high levels of evaporation of stored water in a dam reservoir.

Relationship with the Sustainability of SSI

An inability to control water losses can dramatically exacerbate the present existing feasibility issues troubling SSI in Ethiopia (see full discussion of feasibility/ sustainability issues in the next section) or erode the achievement of the performance indicators[12] associated with reaching commitments made to USAID about intermediate results; these other issues include:

- adding to the difficulties with predicting available surface water for irrigation and the overall planning of the scheme;
- generating user dissatisfaction which demotivates community interest in careful operations and maintenance;
- increases the marginal costs of maintenance and repair beyond those justified by the production gains;
- leads to social conflict because part of the user community does not receive the benefits expected; and
- undermines the expected returns, increasing the unit cost for irrigation and diminishing the rationale for choosing SSI as a food security strategy option.

[12] Although a full discussion of the performance indicators associated with Title II-funded Small-Scale Irrigation is beyond the purview of the present report, the Team has assumed that the actual number of beneficiary households able to participate in irrigated agriculture and the annual size of the command area are better indicators of performance than the number of schemes constructed or the anticipated total command area. Despite significant efforts at building headworks and primary canals, the real measure of the effectiveness of these programs can only be judged on how they are actually used. It is, however, considered legitimate to allow a few years for the schemes to reach their full potential, in terms of total annual command area, households accommodated within it, and finally, in terms of real production increases.

Stage at Which Issue Arises

The matter of leakage – out of unlined canals or through earthen dams – are concerns which must be carefully assessed during both the design and construction phases. Ample irrigation engineering guidance is available (see the ESRDF manual) to enable project proponents to consider the potential for such problems and avoid them. Faulty use of irrigation water occurs during the operations of the scheme when farmers apply more water than the crops require, use flood irrigation where water volumes are more difficult to control, or unnecessarily extend the length of tertiary canals or furrows. Leakage as a result of broken or faulty canals is most often the result of improper maintenance of the system.

Detection and Monitoring

Logically, it would seem relatively easy to detect and monitor for leakage problems; visual inspection of the canal system or below the dam for the appearance of wet spots or seepage would certainly suffice. Over-use of water by individual farmers may be more difficult to measure. The challenge, however, is knowing when there is a problem, why it is occurring and how to choose the proper mitigation measure; this is the all-important qualitative dimensions of monitoring. For example, after a good rainfall year, leakage may not have an impact on the overall effectiveness of the system as there could be surplus water. This situation calls for **a combination of physical and social measurements** which help to relate cause and effect.

Like any good monitoring system, **an ability to detect change (positive or negative) depends on a solid foundation of data, information and understanding of the base conditions**. In this case, the total amount of water available for irrigating the crops. This figure, in turn, will have been used to decide the annual area within the command area that could be irrigated in the dry season and, hence, the number of participating households that will have irrigated plots.

With **diversion systems**, leakage or loss of water for any reason becomes more important in schemes where the catchment area is degraded and/or in poor rainfall years. Higher flooding and reduced rainfall infiltration lead to lower lean flows. At present, the dearth of a good system of stream gauging and meteorological stations in rural Ethiopia and the consequent lack of an historical record of rainfall and stream flow makes it extremely difficult to assess the expectations about irrigation water availability in a diversion scheme (see additional

Table 5.1: Headings for Table Measuring Water Availability				
Water Height at the Gauge	Water within Live Storage (m3)	Adjustments for Leakage, Consumption and Evaporation	Net Water Available for Irrigation	Potential Command Area Under Normal Cropping Patterns

discussion of this topic in **Chapter 6**). It is quite possible that because lean flow measurements were only available for a few years prior to the construction of the scheme, the actual lean flow could be either substantially higher or lower in a given year.

In **storage systems**, assessing water availability and the impact of leakage is less of a problem because water stored behind the dam can be easily measured with an installed water level gauge. The assessment of water availability will also have to take into account evaporation as well as consumption by animals and local people drawing water from the surface of the impounded water. There may also be a possibility of continuing in-flow into the reservoir. It is important to remember that it is the "live storage" area which represents the amount of water available for irrigation. Over time, those in charge of a storage reservoir system should develop a table of its storage behavior that takes all these factors into account in order to be able to better predict the water available for irrigation and thus, the size of the command area at the start of the irrigation season each year. Such a table might have the following headings such as those shown in Table 5.1.

Brokering a response and the resolution to these situations will require both technical skills and knowledge and community participation. The first and most important step is to begin with reasonable assessments of water availability and take all factors into account so that you know what to expect, i.e., water flow in the system and the potential command area that could be irrigated. (See Box 5.1.) **In the absence of a sound historical record of lean flows, the primary decisions about the size of the scheme will require an exercise in judgement and conservative estimates regarding the possibilities**. These estimates will be helpful during the decision-making process concerning the need for lining a canal and the marginal costs for doing so. These estimates will then need to be compared with projected returns from the command area.

Early on, however, in the planning and decision-making process, **all systems should install both stream gauging stations, or water level gauges and basic meteorological stations** as part of the investment. Local personnel should then be trained to carry out and record the measurements. Over the course of the first few years of operations, it should then be possible to elaborate **a site specific table of water availability** that relates the annual rainfall, condition of the catchment and water availability for irrigation in the scheme. Having this information to hand is the only way to make sound decisions about additional canal lining, changes in crop choices or land re-distribution adjustments, should they be either possible or necessary. Having this information will allow the community to understand the realistic parameters of resource use and distribution and reinforce the social agreements about limitations of water use and proper irrigation regimes, thus avoiding needless social conflict.

Suggested Mitigation Measures

Utilizing scarce water resources effectively and efficiently in small-scale irrigation schemes will require **a combination of technical solutions and adaptations of human behavior**. The following measures are suggested for improving the present difficulties with the efficiency of irrigation water use, both within existing schemes and in the lead-up to the establishment of new schemes:

- **Starting with a Proper Assessment of Available Irrigation Water**: As the previous discussion has stressed, the baseline understanding of the amount of water available for SSI is fundamental to many other decisions and practices related to the sustainability of the scheme. It is suggested that the group of Cooperating Sponsors work together to develop **a standard methodology for realistic and conservative projections of available water and irrigable area under each of the SSI types** – spring, diversion, storage and spate systems. Having done so, a range of additional, practical actions then become possible and more coherent; they include:
  - Developing further field-informed guidance on the applicability and adaptation of **design and construction standards and norms** that can

Box 5.1: Understanding the Assessment of Total Water Availability

This very mundane element of irrigation technology is presumably well known, but worth repeating. For Diversion Systems, a formula and/or table of the following type could be developed:

LEAN FLOW of the stream measured, ideally, over many years. Present measurements techniques use a flume of known cross-section into which all streamflow is diverted, and a float whose velocity through the flume is timed, to determine liters per second of flow. Some conversion factors: 1 L/sec = 60 L/minute = 3,600 L/hour or at 1,000 L/m^3 = 3.6 m^3/hour.

multiplied by a

DEPENDABILITY FACTOR (typically the 75 percent rule in modern irrigation technology but where measurements have not been taken, the percent reduction factor could be increased to be on the safe side, say to 50 to 60 percent). As an example, a stream measured at 6 liters/second could in principle be tapped (only 2/3 or 66 percent of the total or 4 liters/second) for irrigation purposes over a 24-hour period.

multiplied by a

CATCHMENT QUALITY FACTOR (increase or decrease according to the status of the catchment and its degradation/rehabilitation; a factor that could change as efforts to rehabilitate the catchment take hold). Here again, this would be a percentage figure.

multiplied by a

RAINFALL YEAR FACTOR (increase or reduce according to the percent of average rainfall). Another percentage figure, based on the estimated percentage of average rainfall; it could be less than 100 percent or more in good rainfall years.

minus the

AMOUNT OF WATER REQUIRED BY DOWNSTREAM USERS or for **MINIMUM ECOLOGICAL FLOW**. Calculated, estimated or determined according to other project or local data, in liters/second.

equals

TOTAL NET AVAILABLE WATER. This figure expressed in liters/second of water which can be diverted into the main canal. For each liter per second flow, the system carries 3.6 cubic meters per hour or sufficient water to cover 3,600 square meters (0.36 hectare) with one millimeter of water.

divided by the

CROP WATER REQUIREMENTS: The average crop water requirement for cool season crops in the highlands is considered to be between 2 to 9 mm/day or the equivalent of 20 to 90 cubic meters of water/hectare/day, depending on whether humid or arid conditions. Table 5.2 converts daily consumptive use rates to equivalent continuous flow rates per unit area (hectare).

multiplied by the

NUMBERS OF HOURS PER DAY OF IRRIGATION: the figures above assume 24 hours continuous flow; if the water is used for only part of a day, the flow rate must be increased by a factor representing the day length. Half-day (12 hours) irrigation means the figures must be doubled. So in order to irrigate a crop of sorghum, assuming 3 mm consumptive use, 10 hectares and half-day irrigation, the equivalent flow rate in the diversion would have to be (0.35 x 2 x 10) 7 liters/sec.

multiplied by the

TYPICAL CROP MIX foreseen for the scheme. For example, the farmers may be planting two different crops under irrigation whose water requirements are sufficiently different as to merit this distinction.

equals

COMMAND AREA: A net available water rate of 12 liters/second would be adequate to irrigate 17.14 hectares of sorghum (3 mm consumptive use and half-day irrigation)

divided by the

AVERAGE SIZE LANDHOLDING: Assuming the average irrigated plot holding was to be 0.20 hectares.

equals the

NUMBER OF BENEFICIARY HOUSEHOLDS that could potentially be accommodated within the command area: (17.14 hectares divided by 0.20) equals 86 households.

Table 5.2: Conversion from Consumptive Use Rates to Equivalent Continuous Flow Rates per Unit Area					
Consumptive Use of Water by Crop–Humid Conditions (mm)	Equivalent Continuous Flow Rates per Hectare		Consumptive Use of Water By Crop–Arid Conditions (mm)	Equivalent Continuous Flow Rates per Hectare	
	Liters per Second	Cubic Meters per Day		Liters per Second	Cubic Meters per Day
2	0.23	20	6	0.69	60
3	0.35	30	7	0.81	70
4	0.46	40	8	0.92	80
5	0.58	50	9	1.04	90
Source: Booher, L.J., 1974					

be applied to the individual site. Because the present activities of the Cooperating Sponsors represent a significant portion of the current promotion and development of SSI in Ethiopia, they should look to the CO-SAERs and other agencies and technical assistance teams for synergy in the development and perfection of country-wide guidance of this nature.

– To the degree that the designs are sound, there will be **an enhanced opportunity and capability for cost/benefit analysis** and an ability to analyze the returns on design and construction options and investments. It is important to bear in mind that cost benefit analysis at this stage is not about whether or not to feed hungry people (although presumably a site-wise analysis of the cost and benefits of establishing SSI has already been preformed; see additional discussion below) but how to do it most effectively and efficiently.

- **A Start-Up/Break-In Phase**: The Cooperating Sponsors should acknowledge the need for and embrace the notion of a startup period for fine tuning the system and its user standards and practices. Although the adjustments may be technological in nature, they should be built on a firm basis of the community understanding of the value of the resource. During such a period, scheme proponents (the Cooperating Sponsors) should work with the Water Users Association in a proactive manner to test methods such as:

– the **incremental sizing of the command area**; starting with a smaller area, based on conservative estimates of water availability and building up the scheme as experience about the lean flow period becomes available, from year to year.

– **reconsidering the choice of crops** that will offer optimum increases in productivity and/ or income for the largest number of users with the resources available to the water users association.

– working collectively and with other members of the community on **catchment protection and rehabilitation as an insurance policy** for the future water supply.

The idea of a start-up or break-in phase, however, suggests a need for **a reconsideration of the present institutional relationships and procedures related to the handing-over of the scheme** to the community, the Regional Bureaus and the Development Agents. Would a Development Agent, with the present, or even an enhanced level of training, be able to assist the community to compile the information, analyze the options and adjust the way the scheme is being operated?

- **Conservation of Available Irrigation Water**: All proponents of SSI need a clear rationale and methodology for considering the need for and analyzing the case for lined canals or even closed conduit (pipes) water conveyance or similar choices related to water conservation.

– It is important to remember that while **lined canals (or pipes)** may be marginally more costly, they also present opportunities for multiple benefits:

-- water conservation (avoidance of seepage loss, water logging and evaporation) is enhanced;

-- soil and/or water management becomes easier to control; and

-- health hazards are reduced.

– There are **other technological adaptations** that should be considered, including:

-- the utilization of **controlled water outlets (gates)** from main and secondary canals which make water volume easier to control, thus improving water management, avoiding erosion and stagnant water and making water management less labor intensive and facilitating canal maintenance; and

-- the use of **siphon technology** as an option from drawing water from the canals.

- **Efficient Farmer Use of Available Irrigation Water**: Farmers, particularly those of the target areas of these programs, have an implicit understanding of resource scarcity. It is a well-known fact that rainfall in the Ethiopian highlands may be limiting or soil fertility poor. The key to overcoming inefficient use of scarce water resources lies in bolstering these understandings and avoiding overly optimistic assessments of available irrigation water and command area size. The following suggested mitigation measures build on the important notion of valorizing the resource base so as to ensure efficient use of this scarce and precious resource. This is particularly important for new schemes being developed in areas where there is little or no irrigated agriculture traditions. Among the methods that could be tried to ensure efficient water use among the farmer participants, are:

– The establishment of **a system of water user fees, linked to consumption** which underwrite and reinforce the notion of the value of the resource and provide individual motivation for wise use and conservation.

– **Careful training of the Development Agents, water user association officers and farmers** will be essential to building the local understanding, management capabilities and community responsiveness to the issues of scarce resource and production trade-off decision-making.

– **Crop choice in expected bad years** may be one of the best ways to deal with likely shortages of irrigation water but this will require a few years of experience with both water availability and the transparent and effective functioning of the water users association.

– It may also be useful to consider the options of **night storage and/or night irrigation** but this will also mean a study of its impact on possible downstream users or the ecology of the water source.

5.3.2 Soil Fertility and Quality Maintenance Problems

The purpose of small-scale irrigation in the food insecure areas of Ethiopia is to provide additional production capabilities and opportunities for small-holder households. Providing irrigation water can add resilience to rainfed farming systems by ensuring the availability of water for supplemental irrigation to overcome erratic rainfall patterns during the main rainy season. Similarly, depending on crop choice, irrigation gives farmers the option for second and even third season production, thereby enhancing the productive capability of the otherwise limited human environment. Unfortunately, these same opportunities for intensifying agricultural production can have deleterious effects on the quality and fertility of the soils of the irrigated plots. This potentially negative environmental impact is a particular concern in the Ethiopian highlands where relatively high demographic pressures have led to decades of continuous use of farm plots and a significant problem of soil degradation and topsoil loss from erosion.

Issue and Implications Statement

Irrigation increases cropping intensity which in turn results in increased removal of nutrients from the soil. If nutrients are removed more rapidly than they are replaced, the system will not be stable, the resource base of the soils will be degraded and crop yields will be reduced. Intensive cropping can lead to deficiencies of the three major elements – nitrogen, phosphorus and potassium – and of some of the minor or trace elements such as sulphur and zinc. Similarly, it is important to bear in mind that irrigation water can leach soluble nutrients from the root zone, particularly if it is applied in excess of the crop's water requirements.

It was noted by the PEA Team that fertilizer use is considered a common requirement for successful small-scale irrigation. Promotion and provision of fertilizer is

When Should Canals be Cleaned

Photo by T. Catterson

This photo, taken in late November on a storage system in Tigray, prompts the all-important question: when should canals be cleaned? Most respondents suggested that it was too early, or at best, just about the right time to clean the canals as dry season irrigation would get underway in late December. But does a canal languishing without cleaning since the end of the rainy season not lead to increased incidences or opportunities for breeding of disease vectors?

expected to be part the responsibilities of the Regional Bureau of Agriculture when they take over a scheme after it has been constructed by one of the Cooperating Sponsors. In a number of the sites, the Team observed that farmers did indeed have access to credit for fertilizers and were using them on their irrigated plots. Farmers were most commonly applying diammonium phosphate (DAP) and urea at rates of 50 kg/hectare for grain crops and 100 kg/hectare for vegetables. Yields of maize were reported to be increased by a factor of two to four with the application of fertilizer alone. Compost, manure and ashes were also said to be used by farmers at several sites.

The capabilities for fertilizer use, and the technology related to it, is still an area requiring considerable attention in the modernization of agriculture in remote rural areas of the Ethiopian highlands. Although the use of fertilizer was widely recognized as an essential component of the package for intensified irrigated agriculture, it was also noted, however, that the Development Agents (DAs) assigned to the scheme areas typically had little experience with irrigated agriculture. They were often hampered by a lack of transport which minimized their ability to visit outlying scheme areas and provide extension services to the farmers. Similarly, the availability of commercial fertilizers is far from assured as the country makes the transition from state subsidized fertilizer distribution to one more linked to the free market. Rates of application of organic amendments in general are very low as crop residues are commonly removed for animal fodder, fuel, fencing and house construction and only a portion of manure produced is collected and applied to the fields.

Relationship with the Sustainability of SSI

Very obviously, problems of soil fertility in SSI will undermine all of the basic premises of any small-scale irrigation development activity.

Stage at Which Issue Arises

Although the issue of yield decreases associated with declining soil fertility and quality will typically be noted during the operational stage of SSI, it is an issue that should be addressed from the outset of project planning. A number of factors will influence the response to the problem – such as crop choice, agronomic practices, the availability of commercial fertilizers, and proper watering regimes – all of which will best be considered during the planning stage. Many sites that will become part of the irrigation plots may be among those most heavily used in the past and attention should be given to augmenting/maintaining soil fertility right from the start of the project.

Detection and Monitoring

Farmers and project personnel will **observe yield decreases**. Nutrient deficiency symptoms can be detected, diagnosed and recommendations made for overcoming them by trained agronomic personnel. Here again, however, early detection of a problem will be facilitated by **having information available regarding expectations of crop yields**, something which was presumably part of the project feasibility study. Because SSI may also involve considerable innovation as farmers become familiar with irrigation technology and, in some cases, with new crops, the early years may require a certain degree of farmer experimentation. This is part and parcel of what has been termed the early period of adoption and adaptation of the technology, bringing it up to optimum effectiveness and efficiency, that should take place during the first few years of project operations.

The need for such experimentation and adaptation is one of the reasons why **demonstration plots for farmer oriented field testing were recommended**. To facilitate such a learning process, it will be important to **encourage the farming community to follow certain standards and maintain minimal records**. Whether this procedure will be a part of the demonstration plot or on their own fields, it will be necessary so that “cause and effect” can be more easily determined when attempting to interpret less than ideal yields. The challenge of “fine-tuning” the production techniques and, in particular, the correct application of chemical fertilizers as soil fertility amendments, increase the demand on the services and capabilities of the Development Agents.[13]

Nitrogen and phosphorus are two nutrients generally applied as fertilizer which can cause water-quality problems. Phosphorus is readily adsorbed in soil particles and as such can be carried in surface run-off. Nitrogen is very soluble and can be present in both surface and sub-surface drainage waters. However, under present and foreseeable conditions, the economic and practical

[13] The ESRDF Manual contains an extensive section (Component IVB-2) on Irrigation Agronomy for small-scale irrigation. This manual and other materials could help in the need for more training and the preparation of a field manual for D.A.s on irrigated agriculture.

constraints on chemical fertilizer and manure usage limit the amounts applied to levels such that water pollution should not be a problem. Vigilance, however, is recommended; part of the eutrophication problem currently emerging in the lakes of the southern part of the country is thought to originate in run-off from adjacent irrigated areas.

Suggested Mitigation Measures

Application of chemical fertilizers is the most common means of restoring nutrients and is currently being promoted by the Ministry of Agriculture. However, its use should be tempered, taking the following factors into consideration:

- Maintenance of soil productivity depends on maintaining adequate levels of soil organic matter for retention and uptake of nutrients, maintaining essential microbial activity and water holding capacity and soil structure. Chemical fertilizer alone will not maintain soil productivity over the long-term. Intensive cropping, without addition of organic amendments will result in a decline in soil organic matter content. This situation is exacerbated in the case, as is common in Ethiopia, where crop residues are routinely removed from the field.
- Although a good response to applications of nitrogen, phosphorus and potassium may be obtained over time, deficiencies of other nutrients are likely to limit crop production. It will then become necessary to properly detect and address these deficiencies as well.
- Given the present precarious nature of the availability and the costs of chemical fertilizer, heavy dependence on these commercial amendments as an external input can put the farmer in a vulnerable position.

In view of the above, although judicious use of chemical fertilizer may be recommended, **complementary or alternate techniques for maintaining soil productivity** should be promoted. Good land husbandry practices including the application of animal manure, inclusion of legumes in the crop rotation, and appropriate water management must be encouraged. Project planners may wish to consider the opportunities for system layout that allows for command area rotation and fallow periods. Although limited water may only be able to irrigate a given command area in the dry season, in certain cases, it may be possible to design a scheme layout that provides for alternating the irrigated plots from one side to another within a larger command area. Similarly, promising research is underway on developing new techniques for maintenance/enhancement of soil productivity by biological means. As these emerge from the research/testing "pipeline," they should be quickly experimented with for applicability to the irrigated crop farming system.

5.3.3 Soil Salinity Problems

Soil salinity problems with irrigated agriculture are well known in Ethiopia, particularly in the large-scale irrigation schemes of the Rift Valley and, indeed, around the world. Salinity is thought to affect more than a third of the world's irrigated agricultural lands. (El-Ashry, 1980, as quoted in Tillman, 1981) "For irrigated lands in arid and semi-arid regions, where salinity problems are most common, even good quality irrigation water (200 ppm soluble salts) can add 0.2 tons/hectare of salts with a normal water application of 10,000 m^3/hectare/year. (Massoud, 1977, as quoted in Tillman, 1981) Indeed, salinity may contribute significantly to the fact that "massive tracts of irrigated cropland are going out of production at nearly the same rate as the amount of new irrigated lands are being added." (Biswas et al, 1980, as quoted in Tillman, 1981) Salinity problems were visually observed by the PEA Team on a number of SSI

Table 5.3: Measuring Salinity

Levels of Irrigation Water Quality and Salinization:*

Conductivity (mmhos/cm)	Salinity (gm/lt)	Water Quality
0 -0.5	0 - 0.32	Good
0.5 - 2.2	0.32 - 1.4	Average to poor
> 2.2	> 1.4	Unsuitable for Irrigation

Ethiopian Ministry of Agriculture Soil Salinity Classification:

No.	Salinity Class	Degree of Salinity
1	Non- saline	ECe below 4 dS/m
2	Slightly saline	ECe 4 - 8 dS/m
3	Medium saline	ECe 8 - 15 dS/m
4	Highly saline	ECe > 15 dS/m

Note: dS/m- deciSiemens/metre, measured of a soil sample with an electrical conductivity meter.

***Source**: Hugues & Philippe 1992

sites, appearing as easily identifiable white salt deposits on the soil surfaces.

Issue and Implications Statement

Perennial irrigation invariably raises the water table and dissolved salts are transported by capillary action into the root zone, deposited on the soil surface and left behind when the water evaporates. The salt inhibits plant growth by disturbing the osmotic relations in the root zone, causing declines in crop productivity. More specifically, salinity affects agricultural soils by destabilizing their structure, affecting microbial life with consequent declines in porosity. It affects plants by decreasing the available water for plant growth, deregulating mineral uptake and causing physiological stress.

Salinization of irrigated lands is mainly caused either by applying saline water or because the soils themselves have appreciable levels of soluble salts. In either of the above situations, salinity problems are further exacerbated by conditions that lead to high water tables such as impeded drainage, stagnation of water in low-lying parcels or depressions in crop fields, regular seepage from higher elevations, leakage from canals or earthen dams or through the excessive application of irrigation water.

Notably, there are very few SSI schemes, at least among those seen by the PEA Team, where drainage canals and outlets were part of the basic construction. In all likelihood, this is because the current approach to construction and handover to the community implies that the tertiary (and sometimes the secondary) canals should be built by the water users. Drainage lines can only be properly located once the full array of the canal and plot structure is in place and community members may not either see the need for drainage or be willing to sacrifice land (or labor) however small, within the command area for this purpose.

Relationship with the Sustainability of SSI

Because of the serious possibility of large scale productivity losses associated with salinity and due to the frequency of the problem in Ethiopia, it has the potential for gradually undermining the productivity achievements of SSI. Even more worrisome is the fact that treating advanced cases of soil salinity are both technically challenging and costly. Where schemes have been mistakenly built in areas with soils having an inherently high soluble salt concentrations, "the cost of remedial action for successful agriculture may exceed the economic benefits." (Tillman, 1981)

Stage at Which Issue Arises

Although a salinity problem will most likely manifest itself during the operational stage of a small-scale irrigation scheme, in most cases, the potential for the problem arising can and should be identified during the design and planning stage. As the section immediately above suggests, building SSI on areas where there are inherently high soluble salt concentrations should be avoided. During the construction stage, it may be possible to take corrective actions that avoid the onset of the salinity problem; soil profile modification through deep plowing and installing adequate drainage canals and outlets are two such actions although both add significantly to construction costs.

Detection and Monitoring

The visual evidence of salinization is easy to detect – white salty residues appearing on the soil surface. By the time these deposits can be seen, however, salinity has most probably already reached, or was at, a level sufficient to affect crop yields. Dealing with salinity requires a reasonable quantitative estimate of the problem, usually determined by measuring the salt content of a sample of the irrigation water or of the soil with an electrical conductivity meter.

The latter sampling process is usually carried out during the detailed planning stage, by the same laboratory that is performing the basic soils analyses (texture and pH). The salinity of the irrigation water may be measured using an electrical conductivity meter with a sample taken near the proposed abstraction point. Critical salinity levels are usually reached at minimum lean flow and these measurements, whether pre-project or routine monitoring, should be taken at the same time. Once salinity levels are determined, reference tables, such as those shown in Table 5.3, can be used to determine if the problem is serious and how to address it. There has been enough experience with the salinity issue in Ethiopia that the Cooperating Sponsors should be able to ascertain if there is a likelihood of it occurring in the specific geographical area in which they are working, and, thereby, ensure that adequate testing of soils and irrigation water is undertaken.

Suggested Mitigation Measures

Salinity is very clearly one of those environmental issues best avoided at all costs; sometimes the rehabilitation efforts and the costs associated with them

Big Investment – Big Threat

Photo by T. Catterson

This large and actively eroding gully flows into a storage reservoir just above the dam on a site in Tigray. The amount of sediment flowing into the reservoir will doubtlessly decrease the useful life of the scheme dramatically. The large catchment above the gully and its evident degraded condition make dealing with the problem an enormous challenge.

Major Structure and Minor Returns

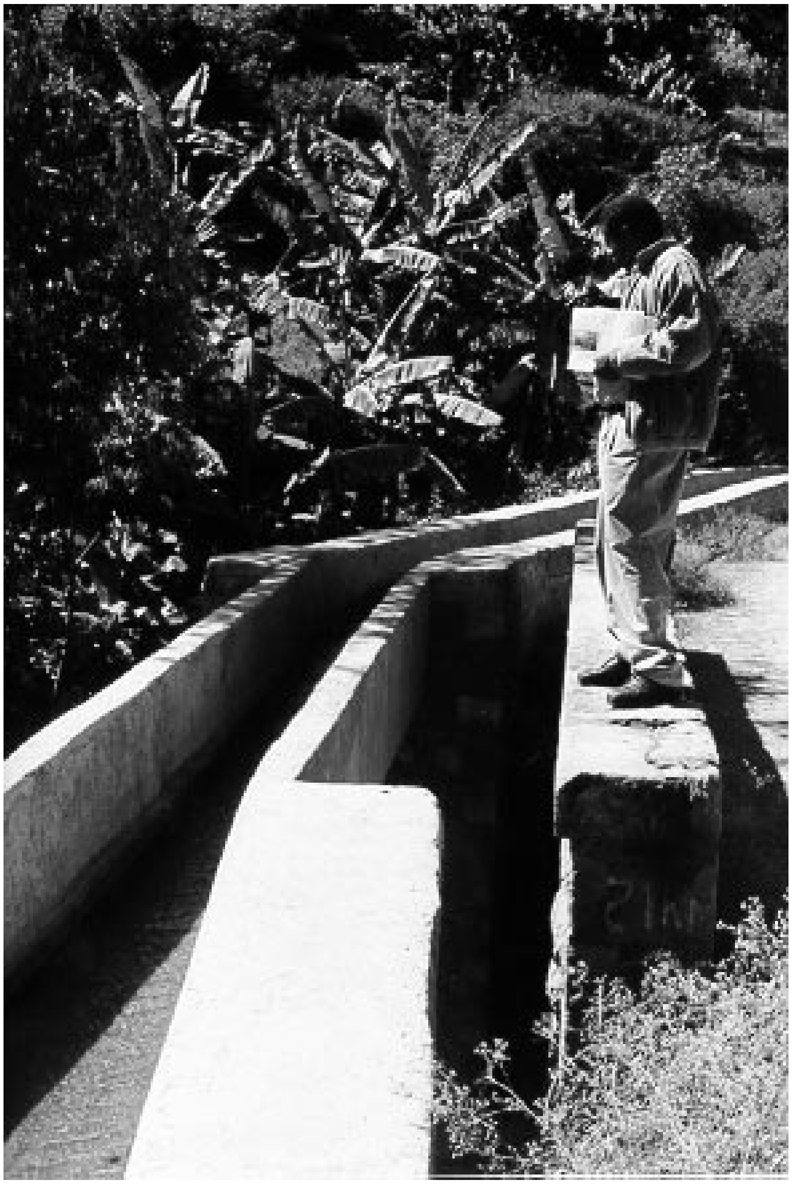


Photo by T. Catterson

On this site in Eastern Hararghe, the sponsor built a sophisticated aqueduct to carry water over the river and along side the road, replacing a wooden flume that often leaked and broke. Unfortunately, only 20 meters beyond this structure, the primary canal could not be completed because no agreement had been reached about carrying water through a Government nursery area. The farmers had been forced to break the canal and use an unlined and lower location, diminishing the size of the command area below.

can be substantial, leading to poor returns on the investment. Where avoidance is impossible or where there is a chance for salinity emerging during the productive life of the scheme, an array of measures can be taken to address the issue and mitigate its impacts. These include:

- **Crop choice**: Selection of salt tolerant crops can lessen the impact on yield. Crops such as cotton, barley, wheat and sugar beets are, for example, known to be more tolerant of salty conditions than maize or beans. It may also be possible to identify some genetic varieties of common crop species which are more salt tolerant than the most common varieties. This is an area of potential research exploration. Cooperating Sponsors would be wise to develop an indicative table of salt tolerance for SSI crops.

- **Leaching**: This technique calls for spreading fresh water on salinity affected soils in order to wash down the salts below the root zone of the crop plants. It can only be carried out in the rainy season when rainfall can add to the fairly substantial amounts of water (50 mm equivalent for most traditional shallow rooted field crops) needed to wash the salts out of the root zone. Then too, the quality of the irrigation water will need to be factored into this practice.

- **Leaching and drainage**: Leaching combined with the provision of a good drainage network throughout the scheme provides more satisfactory and lasting results. It will add considerably to the maintenance costs for scheme upkeep and will likely require a re-allocation of at least a part of the plots in order to make way for drainage structures. Care should also be taken to avoid a "knock-on" effect whereby the salty water removed from upstream sites does not result in downstream water quality issues for other users.

- **Pre-Planting irrigation**: Salts often accumulate near the soil surface during fallow periods, particularly when water tables are high or the seasonal rainfall is below normal. In such instances, an application of pre-planting irrigation water reduces the chances of low rates of seed germination and seedling survival.

- **Seed placement**: This practice involves adjusting sowing practices to ensure that the soil around the germinating seeds is low in salinity. This can be achieved by selecting suitable practices or seed-bed shapes. For example, in furrow irrigation, double-row raised planting beds where the seeds are placed near the shoulder of the bed provides better results in germination than single-row raised seed-beds where planting is done in the center, as salts can be expected to concentrate in the center. Similarly, planting on sloping beds with the seeds placed on the sloping side just above the water line provides better salinity control than planting at the top of the ridge where salts will concentrate.

- **Deep plowing**: Although this practice, mentioned above, may be recommended, it may be difficult for the farmers to carry out. Deep plowing if performed before leaching often provides satisfactory salinity control where the soils in the command area have layers than impede water penetration. Reaching the required depth, approximately one meter for traditional, shallow rooted crops, may not be possible with the present oxen/wooden plow configuration typical of rural Ethiopia; it may be necessary to bring in mechanized means to use this practice if it is required.

5.3.4 Soil Erosion

Many of the farm lands chosen for SSI in the Ethiopian highlands occur along relatively narrow valley bottoms. Irrigation is achieved by carrying water from an upstream diversion higher in the valley, along the contour, and releasing it downstream onto the command area. In general these areas are uniformly flat areas where the slope does not exceed two percent and thus water management within the scheme need not be concerned with the issue of erosion. There were, however, a number of sites where in order to utilize the irrigation potential, some portion of the command area contained steeper slopes, five percent or greater, and there was a potential for erosion. Similarly, large-scale earth movements and borrow pits associated with earthen dam construction occasionally have a potential for erosion, leading to premature filling in of the dead storage area within the reservoir.

Issue and Implications Statement

Erosion within the irrigation command area has several detrimental effects. These include depletion of soil nutrients and organic matter content because topsoil is carried away, washing out of crop seeds, exposing the plant roots and run-off spilling out of the command area and degrading downstream water sources. Over the longer-term, if erosion persists, it will result in the reduction of

A Massive Undertaking That Disadvantaged Many

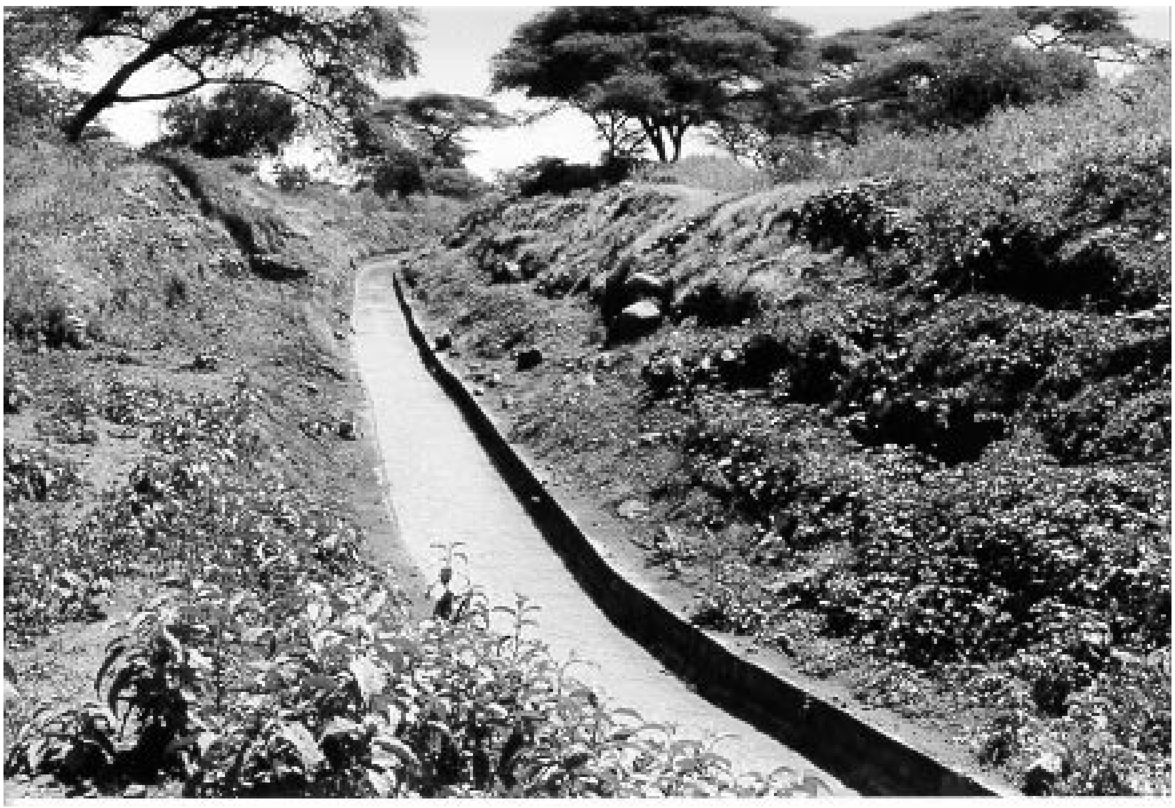


Photo by T. Catterson

This large primary canal on a diversion scheme in the south increased the water in the system and allowed more land to be irrigated. Unfortunately, and despite plans to the contrary, the weir and this canal were built about 100 meters below the traditional weir they replaced, changing the location of the command area significantly and leaving a large number of families without access to irrigation that they once enjoyed.

the soil depth affecting the water and nutrient holding capacity of the crop soils.

When the slope of the plot is excessive and flood irrigation is being practiced, erosion may occur. Slope problems within the command area are exacerbated when the flow volume and velocity of irrigation water attains enough energy to both detach and transport soil particles within the fields. Typically, slopes between two and five percent can be satisfactorily irrigated, provided that the plot layout is appropriate and bunding and terracing are practiced. Slopes above five percent will need specialized land leveling and terrace construction. Although this may be feasible, it adds considerably to the labor burden of the farmer users. In some cases, plot size and animal traction-based plowing capabilities will be inadequate for dealing with the need for land leveling within the command area.

Large amounts of soil excavated from near the dam sites leave borrow pits and areas that are easily eroded. The unprotected and often unconsolidated soils of these areas then wash down into the reservoir basin accelerating the filling-in of the dead storage (and even the live storage) capacity of the scheme, lessening the effective life of the dam.

Relationship with the Sustainability of SSI

Soil erosion is a major problem in the Ethiopian highlands. Many of the sites chosen for SSI have probably been cropped by smallholder farmers for decades and often are already slightly degraded and eroded. Aggravating this problem by attempting to construct SSI on steep slopes will add to the problem, increase the costs of construction and maintenance of the scheme and typically lead to lower yields. Although in the past Ethiopian farmers have been masters at dealing with soil and water conservation on their farm lands, a need to cope with the propensity for soil erosion within the scheme adds to the significantly higher labor burden that irrigated agriculture entails.

Stage at Which Issue Arises

Erosion issues arise and are best dealt with during the design and construction stages. Proper siting of the command area is the key to dealing effectively and efficiently with the potential for erosion within the command area. Because it is likely that the streams feeding a storage system are already transporting silt and sediment from within the catchment, it is vital to avoid construction practices which would add to that burden and decrease the useful life of the dam.

Detection and Monitoring

With proper design, construction and siting, erosion hazards can be minimized. It is, however, important to be watchful for the incidents of erosion occurring within the command area. These can be visually observed and farmers should be alerted to the potential for erosion if slopes are between two and five percent and flood-style irrigation is being employed.

Suggested Mitigation Measures

Although most Ethiopian farmers will have ample background in dealing with erosion, a number of SSI specific erosion control and avoidance practices should be reviewed as part of farmer training packages; they include:

- **Avoiding steep slopes** within the command area. Because currently farmers configure the lay-out of command areas, including the installation of secondary and tertiary canals, they should be cautioned about the need to avoid steep slopes. This caveat may necessitate occasional soil and water conservation engineering practices so as to develop a relatively efficient commandable area and/or avoid a need for land re-distribution.
- **Managing flow velocities** within the canal system is also fundamental, both for erosion control and ease of irrigation water management. Here again, layout of the command area will have a major influence on this factor. It is important to avoid down slope canals where the volume and velocity will be hard to control, canal scouring may occur and irrigation water will erode the crop lands. Depending on local conditions, protected drop structures at suitable intervals, will have to be provided within both the primary and secondary canal systems. Where applicable, siphons to abstract water from the main or secondary canals may be used to minimize volume and provide better control of irrigation water flows.
- **Consolidating and revegetating borrow areas** will be an important means to avoiding and controlling the potentially high erosion and run-off from these highly disturbed areas. Direct seeding with grass or herbaceous plants (some of the leguminous creeper plants such as *Desmodium spp.*) would be ideal.

5.3.5 Water Related Disease Hazards

The primary health risks associated with small scale irrigation projects relate to water and vector borne

Figure 5.1: Guidelines for Intersectoral Cooperation

Developed from: Axtell, R.C. "Principles of Integrated Pest Management (IPM) in Relation to Mosquito Control." (*Mosquito News*, 39: 708-718, 1972.

diseases. These health related environmental impacts is the area in which, in the preparation of their IEEs, the Cooperating Sponsors indicated both significant concern and understanding. Accordingly, reflecting this concern and the implicit contradictions of human health impacts from development activities and the fundamental humanitarian goals of the partner organizations, a good deal of attention was addressed to these matters.

The main diseases of importance in the Ethiopian context are malaria, schistosomiasis, water borne disease (gastroenteritis, intestinal parasites, typhoid, etc.) and lymphatic filariasis. Onchocerciasis has been reported in very limited locations in the extreme southwestern part of Ethiopia. There are four main categories of disease associated with water:

- Disease prevented by washing and bathing
- Disease prevented by clean water supply and sanitation
- Disease acquired by water contact
- Disease acquired from insect bites

The three latter groups can be adversely affected by water development projects but can be prevented to some degree through good environmental management and proactive planning. Water contact diseases, such as schistosomiasis, depend on intermediate hosts with transmission occurring when people have contact with infected water. Projects that increase the likelihood of pools of stagnant water provide rich breeding grounds for malaria carrying mosquitoes. Projects which require large numbers of construction workers run the risk of increasing exposure to disease through contaminated potable water and poor sanitation facilities.

Issue and Implications Statement:

The following sections examine the potential health hazards of the main vector and water-borne diseases of importance in Ethiopia.

Malaria

Malaria continues to be one of the foremost public health problems facing sub-Saharan Africa. In Ethiopia, malaria figures among the top five causes of mortality and morbidity. Environmental changes brought about by expanded land use for agriculture, forestry and human settlement have increased malaria outbreaks in many areas. Malaria in Ethiopia is unstable, mainly due to topographical and climatic factors, with seasonal transmission peaks between September and November after the main rainy season and, in some parts of the country, in March/April after the small rains. This means that most of the population do not develop resistance. Malaria epidemics have been both more frequent and widespread in recent years. These epidemics coupled with the decentralization of the health care system have necessitated a re-orientation to the malaria control strategy.[14] In general, effective control of malaria presents not only significant challenges but also opportunities for encouraging inter-sectoral collaboration both in prevention and treatment. (See **Figure 5.1**) The current focus of malaria control is limited to case management, environmental management, chemoprophylaxis of pregnant women and with a few pilot projects examining the practicalities of using insecticide impregnated mosquito nets (IMNs).[15] In Ethiopia, there are also focal spraying programs, either using DDT or Malathion.

The major malarial vector in Ethiopia is *Anopheles arabiensis*. Prevalence varies throughout the country. In a recent study[16] in the Rift Valley area near Zwai Lake, prevalence varied from 3.6 to 12.6 percent, with an average of 6.8 percent and a peak in September of 12.6 percent. Two-thirds of the cases were diagnosed as *Plasmodium falciparum*; 31 percent were *Plasmodium vivax*. In other areas, the relative frequencies of the two vary. In Toonto Clinic, the nearest clinic to one of the World Vision sites visited near Durame in the Southern Nations and Nationalities Peoples' Region (SNNPR), malaria was the leading cause of morbidity in 1998.

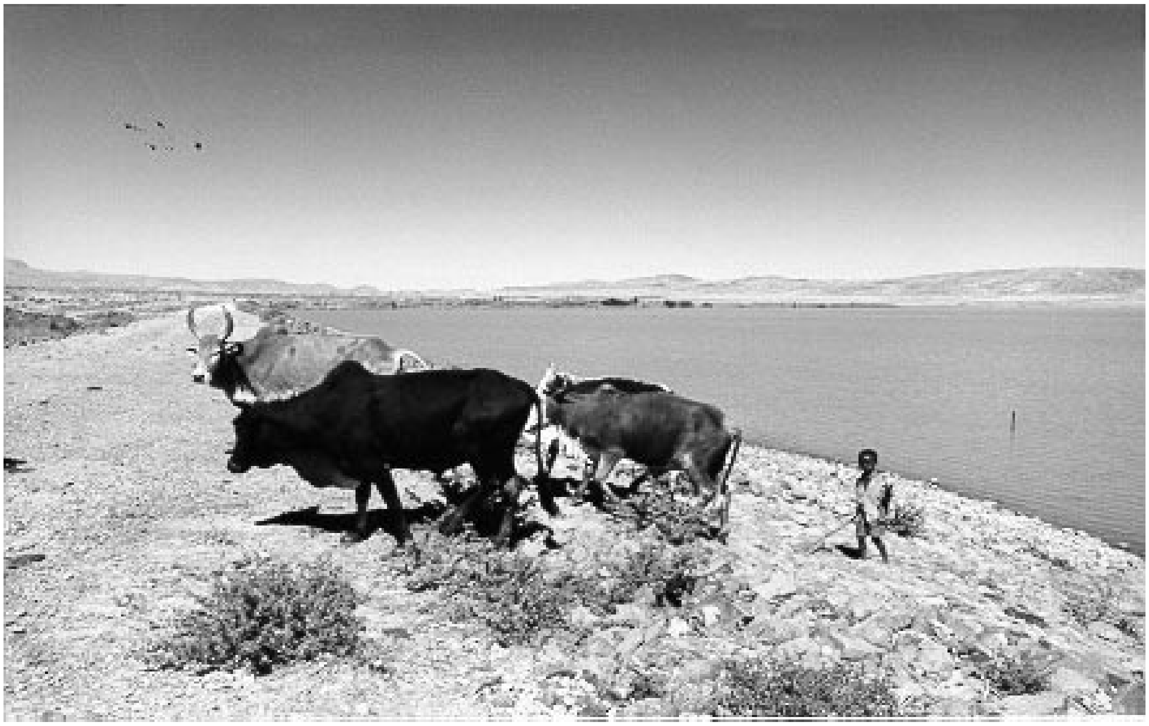
---

[14] Tarekegn Abose, Temane Yeebiyo et al 1998. **Reorientation and Definition of Malaria Vector Control in Ethiopia**. World Health Organization WHO/MAL/98.1085.

[15] In a community based pilot study in Humera, Tigray region, preliminary results indicate a decrease in malaria morbidity from 12 percent to 4.5 percent (personal communication, Department of Malaria control, Tigray Regional Health Bureau). The success of this pilot project has encouraged other regions to undertake similar activities. Whereas there is mounting evidence that insecticide-impregnated nets have a major impact on malaria morbidity and mortality, the widespread use of such nets involved a sustainable community effort and the willingness of communities to provide resources for the initial purchase of the nets as well as for re-dipping. The current cost of an insecticide impregnated net is about Birr 40. Re-dipping needs to take place at least once a year or possibly twice, with an average cost of Birr 5. To date, there are few projects where this has been achieved.

[16] Abose, Tarekegn, Yeebiyo, Yemane et al. World Health Organization 1998. **Re-orientation and Definition of the Role of Malaria Vector Control in Ethiopia**. WHO/MAL/98.1085.

Provide Water and They Will Come



Photos by T. Catterson

Here cows drink below the diversion weir. Unfortunately, they had to cross the main concrete lined canal to reach this spot, possibly adding to its maintenance requirements. The abundant water supplies within this system – witness the amounts flowing over the weir – could have allowed for water to be diverted at convenient and more accessible sites from the main canal. In the top photo, a boy herded his cows right down the dam face, to obtain water, increasing maintenance of the dam.

During the peak season, approximately 50 patients a day presented themselves to the clinic with signs and symptoms of malaria, predominantly *P.vivax*. In a random sample of blood films, positivity rates varied from 89 percent to 69 percent. During the past year, more than 5,000 of 10,791 patients were diagnosed with malaria. In a health post near the Ella Irrigation project in the same region, an upgraded traditional river diversion scheme, malaria also figures prominently in the health facility morbidity statistics.[17] Although there appears to have been a marked increase during the past year, this outbreak is unlikely to be associated with the irrigation scheme, but is much more likely to reflect the general increase in malaria over the past year because of climatic changes sometimes attributed to El Nino.

Since decentralisation in 1993, and with the integration of the previously vertically organized malaria control program into primary health care, national figures have been hard to come by. Some figures are available at regional levels. In the SNNPR, which has a population of 11.1 million, 11.4 percent of all out-patient visits and 33 percent of all in-patient deaths are attributed to malaria. As much as 75 percent of all out-patient morbidity is attributed to poor environmental health and personal hygiene; 75 percent of the region has epidemic malaria with more than two-thirds of the population being at risk.[18] In Region 3, which has a population of 14.8 million, malaria is also a leading cause of morbidity and mortality. During 1990 E.C. (1997/98 G.C.), there were 136,947 confirmed cases of malaria. These figures are likely to only reflect the tip of the iceberg since there is gross under-utilization of health services in most areas on the country.

Irrigation projects invariably increase the amount of stagnant water and, as such, have been associated with the potential to increase the prevalence of malaria. The question which then must be asked is whether the contribution of such a small-scale irrigation project presents a significant risk in relation to the overall prevalence of malaria within the country. In the regions visited during this programmatic environmental assessment, the potential of arable land which could be brought under small-scale irrigation in all cases is well below five percent of the total land area.[19] Therefore, looking at the problem of malaria on a nationwide basis, the prevalence is probably not significantly increased directly due to small-scale irrigation projects. This situation may be different in the Tigray region of Ethiopia where the regional government has embarked upon a program of widespread dam building under their SAERT program. Preliminary communications[20] suggest that there may be an increase in malaria prevalence between villages with and without dams although great care needs to be undertaken in interpreting this preliminary data.

Schistosomiasis

Schistosomiasis is endemic in 76 developing countries with 600 million people potentially threatened and an estimated one third of that figure actually affected. In 1984, 19 million people were estimated to be at risk of *Schistosoma mansoni* and 3.3 million at risk of *S. haematobium* in Ethiopia and Eritrea.[21] Published and unpublished results from surveys in over 400 communities examined for *S. mansoni* since the 1960s in Ethiopia indicate that 80 percent of these communities lie between 1,000m to 2,300m in altitude. The disease is wide spread in the northern, northwestern and central regions of Ethiopia with some endemic localities in the west and southwest. The south and southwest appear relatively free from disease except around the Rift Valley lakes, particularly Lake Abaya. *S. haematobium* is limited to the lowlands of Ethiopia, especially in the vicinity of areas where large scale water resource development projects are being implemented. It is highly prevalent in the Awash Valley of Ethiopia.

Schistosomiasis is clearly a public health issue of major proportions. There are consistent relationships between the prevalence of the disease and irrigation projects. Experience has shown that with the introduction of

---

[17] 1977 E.C. – 1,223 cases; 1978 – 835 cases; 1979 – 1,638 cases; 1980 – 845 cases; 1989 – 1,282cases; 1990 – 2,012 cases. The second most important cause of morbidity was pneumonia. A clear seasonal variation was shown with peak disease incidence in September/October and March/April.

[18] SNNPR Health Sector Development Plan 1990-1994E.C.

[19] In SNNPR, CO-SAERSAR plans for 80,000 hectares (800km^2) out of a total regional land area of 118,000km^2 to be developed under small scale irrigation over the next 10 years.

[20] **Pilot studies on the Possible Effects on Malaria of Small-Scale Irrigation Dams in Tigray Regional State, Ethiopia**. Tedros Ghebreyesus, Asfaw Getachew, et.al. J. Public Health Medicine, 20, 238-240, 1998.

[21] **Schistosomiasis in Ethiopia and Eritrea**. Ed. Hailu Birrie, Shibru Tedla, Leykun Jemaneh. Institute of Pathobiology, Addis Ababa University, 1998.

dry season irrigation in areas previously served by supplemental irrigation, the prevalence of schistosomiasis increased from zero to five percent to 60 percent or more in less than five years.[22] Analysis of the geographical distribution and epidemiology of schistosomiasis must consider climatic, environmental, epidemiologic and human factors. The uneven and focal distribution of infection in Ethiopia has been attributed to the local absence of suitable snail intermediate hosts. Differences in the prevalence of infection in different population groups is determined largely by variations in exposure to infected water and the immunity level of individuals. Results of epidemiological studies in Ethiopia show a characteristic clustering of heavy excretes of ova in school children (6 to 15 years). In most communities, male infection is higher than female infections reflecting occupational differences.

Since the disease affects people who live in rural areas and those who work in agriculture, it is significant that 87 percent of the population lives in rural areas and are mostly engaged in agriculture. The economic and health effects of this debilitating disease should not be underestimated. There appears to be a lack of perception as to the potential importance of this disease. Apart from Tigray, where a study examining community prevalence of schistosomiasis has recently been carried out, no other health personnel considered schistosomiasis an important public health issue.

Schistosomiasis is a chronic disease leading to chronic disability and reduced work capacity. The magnitude of these effects is difficult to appreciate as the people infected usually come from lower socio-economic groups and experience multiple infections as well as malnutrition rendering assessment of the health and economic impact of schistosomiasis alone difficult. The major species which infect humans are *Schistosoma mansoni, S. haematobium* and *S. japonicum. S. bovis* and *S. mattheei* are found commonly in cattle, sheep and other domestic animals. The intermediate vector host of *S. mansoni* is the snail genus *Biomphalaria* and that of *S. haemotobium* is the genus *Bulinus.* The adult worms of *S. mansoni* are found in the mesenteric veins of the portal system and the adults of *S. haematobium* are found in the venous plexuses around the bladder. Eggs are released either in the urine or stool.

Once laid, the egg will develop into an embryo within a week. If environmental conditions are conducive, the egg will hatch and the resultant larva will enter the snail host. These miracidia develop within the snails into cercariae over a period of about four to six weeks. Once shed, the cercariae penetrate the skin of the final host and are transported either to the portal veins in *S. mansoni* or to the veins of the bladder in *S. haematobium*. Egg laying begins after about one month, the presence of a male being necessary for the maturation of the female. Adult worms may live for over 25 years but average life span is three to eight years. Early diagnosis can be made on stool or urine examination. In communities aware of the disease, blood in the urine is associated with *S. haematobium* infection. Recent advances in drug therapy, such as praziquantel, mentrifonate and oxamniquine, can now eliminate and cure infection in a high proportion of an infected population. These medicines, which can be taken orally without the need for immediate medical supervision, revolutionized the treatment of patients with uncomplicated schistosomiasis.

Water-washed diseases

Access to potable water in most of Ethiopia is estimated at about 15 percent.[23] Most people are required to drink water from unprotected sources with resultant high levels of diarrheal disease and intestinal parasites. The supply of potable water and the well-documented effects on improved health are beyond the scope of this report. Suffice it to say that potable water is an important food security option. There is clear need for the parallel development of potable water when an irrigation scheme is contemplated. Irrigation schemes will generally make water more easily available. Unless there is a similar availability of potable water sources, the chances are that people will use the irrigation water for drinking purposes. General low levels of sanitation and the likelihood that livestock will also be drinking from the same source make the potential of water contamination extremely high with resultant disease. It would seem, therefore, mandatory, that development of potable water and the development of small scale irrigation take place concomitantly.

Stage at Which Issue Arises

Water related disease hazards will occur during all stages of an SSI project. The discussion below emphasizes the importance of taking these risks into account from the onset of the project and ensuring a continuous inter-

[22] **Schistosomiasis in Ethiopia and Eritrea**. Ed Hailu Birrie, Shibru Tedla, Leykun Jemaneh, 2nd edition, Institute of Pathobiology, Addis Ababa University, 1998

[23] See Ministry of Water Resources Policy Papers, 1998.

sectoral program approach to dealing with them.

Detection and Monitoring

In many cases, the eradication of vectors is as impossible as the prevention of stagnant water or the avoidance of human contact with water during irrigation. Although these two measures, preventing stagnant water and preventing human contact with water during irrigation, are often touted as appropriate mitigation for prevention of water related disease hazards in SSI, a more basic and primary approach is actually required to get a handle on this issue. It should begin with a health impacts assessment carried out at the onset of the design of the activity.

The objective of examining environmental health impacts associated with water development projects is to reduce the opportunities for vector or water contact through better planning, sound engineering design and mitigation measures during the operational and maintenance phases. The three main components of a health impact assessment should consider:

- community vulnerability
- environmental receptivity
- health service capability

Community Vulnerability

This depends on the prevalence[24] of infection in specific sub-groups, such as children/adults, males/females. It also depends on the proximity to areas where the disease occurs, immune status, previous history of exposure, general health status and the potential effect of an influx of migrants. Birley, in *Guidelines for the Forecasting of Vector-Borne Disease Implications of Water Resources Development*[25] seeks to score community vulnerability into low, moderate and increasing categories.

- *Low vulnerability* might be assigned to a community which is unlikely to be exposed to a parasite although it is reported within the region.
- *Moderate vulnerability* refers to the presence of the disease at or near the project site but relatively few people are susceptible or engaged in behaviour which places them at risk of exposure.
- *Increasing vulnerability* identifies a population which is largely susceptible to infection, in which there is little protective immunity and exposure is likely to occur on a large scale.

Environmental Receptivity

Environmental receptivity to transmission of the pathogen is determined by the abundance of the vector, human contact with vectors or unsafe water and other ecological or climatic factors favoring transmission. For example, malaria transmission is rarely found above altitudes of 2,000m. In Ethiopia, 80 percent of the communities affected by *Schistosoma mansoni* lie between an altitude of 1,000 to 2,300m.

Ranking of environmental receptivity can be viewed as:

- *Possible, but not occurring*: The vector is present in small foci, but there is no human contact or the environment discourages vector breeding at present, although this situation could change.
- *Transmission easily resumed*: The vector has been eradicated but recolonization is likely if vigilance were reduced or as a result of the development project.
- *High receptivity*: There is likely to be an increased exposure to infection. The water development project will create or enhance either vector breeding sites or opportunities for human contact with vectors or unsafe water sources.

Health Service Capability

If an increased health hazard is noted in conjunction with a water development project, the health services need to have the resources to adequately respond to such an increased health risk. This includes detection of cases, provision of drugs, sufficiently trained personnel, vector control and surveillance. A health service that is well placed to deal with a potential health hazard would provide services that include effective preventive measures (such as vector control, disease surveillance and chemoprophylaxis) and effective treatment (trained personnel, access, case detection and drug supply). Some services would be able to provide effective preventive measures, such as residual spraying programs, but be unable to supply curative services and lack trained health personnel. Effective treatment may only be available with no vec-

[24] Prevalence = number of cases/number of people in the community

[25] Birley, M.H., **Guidelines for Forecasting the Vector-Borne Disease Implications of Water Resources Development**. Joint WHO/FAO/UNEP Panel of Experts on Environmental Management of Vector Control, VBC/89.6, 1989.

Figure 5.2: Prevention Promotes Wellness

Pathways to Improved Child Survival and Maternal Health tor control measures. Or there may be no effective health services available because these are over-stretched, under-supplied, unaffordable or inaccessible.

In 1996, the Ethiopian Government announced a Five Year Health Sector Investment Program,[26] which was drawn up to address the major health challenges facing the country. Ethiopian demographic and health statistics are among the worst in the world. Only between 38 to 47 percent of the population has access to health care.[27] Government facilities are underutilised; [28] health services have been seriously underfunded; [29] there is an absolute shortage of trained health personnel; staff have received inappropriate training and there is an inadequate mix of personnel; availability of essential drugs and other supplies is variable and there are frequent stock-outs; public confidence in the health service is poor and morale is low among health personnel. Since the change of government in 1991 and decentralization in 1993, the health sector has moved from being highly centralized, with services being delivered in a fragmented way with reliance on vertical programs, to providing basic primary health care services emphasizing preventative, promotive and basic curative services via a decentralized system of governance. These principles were embodied in a new Health Policy adopted in 1993 and accompanied by increased government and donor investment in the sector. Within this policy, the health care delivery system was also reorganized into four tiers. Primary Health Care Units, each with five satellite community health clinics, provide comprehensive primary care service. Each satellite unit is planned to cover a population of 5,000 people. The other three levels of the health care system are district, zonal and specialized hospitals.

The goals and implementation of the sector investment plan are ambitious. They entail health facility expansion, improved service quality, restructured health sector management, improved financial sustainability, an increased role for private-sector health care and an improved drug supply. In order to achieve the goals set out, there is a need for reorientation and many more trained health personnel. In the interim, service access, quality and utilization remain low. Tigray is probably unique in its current extent of community level health service provision, although progress is slowly being made in the other regions.

Suggested Mitigation Measures

The total health hazard to the community of a SSI project is associated with an assessment of the above three components (community vulnerability, enviromental receptivity and health service capability), their interpretation as health risks and the management of these health risks. The inclusion of an assessment of these risks in the planning phase of a project allows for incorporation of safeguards or mitigation activities in the next stages of the project.[30] Factors contributing towards a community response to such health hazards depend on socio-cultural indicators, prior exposure to an infection, access to health care, general health indicators, a community knowledge of the disease and human behavior. The method of transmission together with the life cycle of the parasite determines whether a high or low frequency of contact between people and vector or infected water is usually necessary in order for sufficient parasites to enter the human host and cause clinical disease. For example, a single mosquito bite can transmit malaria, but it is highly unlikely that a single bite will transmit filariasis. Similarly, a high frequency of contact is required for the development of schistosomiasis.

Experience suggests that in order for project plans to be modified, negotiations must begin at a very early stage of the project cycle. After this, investment in the engineering design is considerable and so are the costs of modification. Each stage of a project cycle provides opportunities to safeguard health. For example:

- **Location** affects exposure to vector-borne disease. For example, earthen dams built above an altitude of 2,000m are unlikely to be associated with any

---

26 Federal Democratic Republic of Ethiopia, Health Sector Investment Program, 1996

27 Defined as being within 10 kms distance from a health facility, irrespective of intermediate terrain.

28 In the SNNPR, there were an average of 0.34 visits/person/ per year, well below the recommended WHO rate of 2.5 visits/ person/year. SNNPR Health Sector Development Plan, 1990-1994E.C.

29 Per capita health expenditure was estimated at approximately $1.20/per capita/per annum. The minimum primary health care package recommended by the World Bank in their Development Report on Investing in Health was $12. FDRE Health Sector Investment Program, 1998.

30 A good example of the use of health impact assessment is described in " **The Use of Health Impact Assessments in Water Resources Development: A case study from Zimbabwe**." Konradsen, F., Chimabari, M. Birley M.H., et al. Impact Assessment, 15, 55-72,1997.

increased risk of malaria.

- **Design** affects the abundance of breeding sites. For example, a river diversion that takes most of the lean flow may increase the number of stagnant water pools remaining in the river bed allowing for increased breeding of malaria carrying mosquitoes.
- **Construction** may mix communities in ways that favors a range of communicable disease transmission. For example, the construction of a dam without accompanying potable water and livestock watering sources increases the risk of exposing a community to unclean water.
- **Operation** introduces conditions for occupational health risks. For example, unlined poorly maintained canals in areas known to harbor snails responsible for schistosomiasis, will increase the incidence of the disease.

If we assume that the benefits accrued from small-scale irrigation projects are greater than the specific irrigation-related health risks, then the question arises as to the how best to mitigate these increased risks. The following section presents some disease specific mitigation measures.

Malaria

Malaria remains a major public health concern. Control has been difficult worldwide. Widespread vector control is difficult and expensive; there is difficulty in accurately diagnosing diseases and increasing cases of drug resistance and patient noncompliance with treatment. As such, it is important that all small-scale irrigation projects acknowledge the potential for increasing malaria prevalence and ensure in all project stages that mitigation measures are undertaken to minimise such a risk. This will involve the following measures:

- Establishment of baseline data on malaria prevalence in the community.
- Early intersectoral collaboration in the planning stages as outlined in **Figure 5.1**.
- Appropriate engineering design to decrease the pooling of water.
- Development of links with health services in order to establish a surveillance system and mobilize community participation in environmental control. This program-oriented approach should include, as much a possible, the reduction of pools of stagnant water; a spraying program; and the provision of livestock watering points. This latter point is so that livestock do not either drink from canals or on the margins of storage reservoirs, thereby risking a break in the integrity of the canal, pooling of water in hoof-prints and/or increasing the potential for water seepage.
- The improvement of health services to promote prevention (e.g., chemoprophylaxis in pregnant women), better diagnosis and quality.[31]

As shown in **Figure 5.2**, malaria control, as an example of vector-borne disease, can provide examples of intersectoral collaboration. Therefore if a SSI project is planned in an area where there is malaria, it is important to bring in all sectors as well as the community from the planning phase, so that mitigation measures can be incorporated and costed into the project activities.

Schistosomiasis

As the basis of schistosomiasis control lies in primary health care (PHC) and community participation, the lack of awareness among health professionals in Ethiopia about the potential spread of schistosomiasis needs to be countered by an active information program. It is particularly important that all professionals involved in irrigation projects be aware of information about the disease and mitigation measures.[32] The specific objectives of schistosomiasis control using the PHC approach is defined by WHO as:

- the control of morbidity by reducing of the prevalence of heavy infection;
- reduction of the prevalence of infection;
- reduction of transmission sites;
- introduction of sanitation and water supplies; and
- reduction of out-patient visits and hospitalization due to schistosomiasis.

---

[31] There has been notable success in the treatment of malaria at village level in Tigray through active community health workers. (Tedros Adhanom, Tesfamariam Alemayehu, Karen Witten et al. **Community participation in malaria control in Tigray region Ethiopia**. Acta Tropica, 61, 145-156, 1996). This is not the case in other parts of the country but unless the treatment of malaria is made accessible, mortality and morbidity will remain high.

[32] **Schistosomiasis in Ethiopia and Eritrea**.

These objectives imply that there is an active surveillance system to detect such changes. Recently, a baseline survey on the community prevalence of schistosomiasis in Tigray region has been undertaken but the results have not yet been analysed. There does not seem to be much work being done in this sphere in other parts of the country. To date there have only been a few pilot schistosomiasis control projects in Ethiopia related to the locally found molluscicide – Endod (*Phytolacca dodecandra*). Difficulties in promoting the wide spread use of this molluscicide stem from the problems with its large scale production and other factors.

There is clear evidence of the spread of schistosomiasis through water resource development projects worldwide. Careful selection and planning of projects is the most effective way of averting the disease. If projects are established in areas conducive to schistosomiasis spread, baseline data on the presence of the intermediate snail host and clinical cases should be determined. Engineering design should be such that water flow in the canals does not allow for snail colonization. The community needs to be aware of the causes of schistosomiasis and the simple environmental measures which can be taken to keep it under control. These include: clearing the canals to prevent vegetation and decreasing human contact with water, for example, by the construction of foot bridges. Health facilities should also be in a position to diagnose and treat cases. Although water supply and improved sanitation are not specific methods for schistosomiasis control, the overall development of such programs will act synergistically in the prevention and control of schistosomiasis.

Water-washed diseases

Currently, the PEA Team was informed that construction workers brought their own water with them. The chances are, however, that people will drink whatever water is available at the construction site. This provides a possible proactive opportunity for the Cooperating Sponsors to provide a tanker with clean water and training or, at a minimum, display health education material on the tanker about the benefits of clean water and the importance of improved sanitation.

5.3.6 Relationship with Sustainability of SSI – Development Opportunities and Synergism

This section of the review concentrates on development opportunities and health implications of USAID Title II-funded small-scale irrigation projects in Ethiopia. Title II resources are primarily used to fund projects in food-deficit areas. Improving household food security can be approached from several angles. From the nutritional point of view, there are a number of different nutritional program interventions such as direct feeding, food supplementation, food stamps and subsidies, each addressing a somewhat different nutritional problem. The common element in both feeding and food-related transfers is that they transfer resources to target households, thereby raising the household's real income.

Other development opportunities related to SSI programs include: increased intake of micronutrients, improving access to reproductive health services, better management of childhood illness and encouraging women's participation and enhancing their decision-making roles at household and community levels.

Improving Nutrition Through Increased Crop Production and Crop Diversification

Small-scale irrigation provides households with opportunities to increase the amount and range of crops grown. In many instances, the crops grown using dry season irrigation are cash crops such as vegetables, fruits, coffee and chat. There are several schemes, particularly in areas where rainfall is unpredictable, where supplemental irrigation is often used to increase the yield of the main cereal crops. These projects, therefore, have the effect of increasing the actual amount of food grown by a household both in quantity and quality as well as offering the potential of buying additional food.

Within a household, children are the most nutritionally vulnerable. Of an estimated 12.9 million deaths under 5 years of age worldwide, between 20 to 75 percent of these are related to underlying malnutrition.[33] Furthermore, examination of all nutrition-related deaths in a population shows that 33 to 80 percent of these deaths are associated with mild-to-moderate malnutrition rather than severe malnutrition.[34] Malnourished children have a 10 to 20 percent greater chance of catching pneumonia with 70 to 90 percent of all deaths from acute lower respiratory tract infections occurring among the malnourished.[35] Clinical vitamin A deficiency is an important cause of blindness in Ethiopia. There is also now a wealth of information that clearly links decreasing child mortality with vitamin A supplementation. Fruits and vegetables that can be grown under SSI are good sources of Vitamin A and other micronutritients.

[33] World Bank - World Development report, 1993

[34] UNICEF 1993 State of the World's Children

Figure 5.3: Conceptual Framework of the Causes of Maternal and Child Health, Nutritional Status and Survival

Therefore, small-scale irrigation has the dual effect of not only increasing the amount but also the quality of household food consumption, thereby potentially decreasing both malnutrition and morbidity due to micronutrient deficiencies. The introduction, however, of such non-traditional food into the diet is new and requires considerable community education in order to gain acceptance. If vegetables and fruit are sold, this is most likely to be undertaken by the women in the household who will attend the local market. Women are more likely then men to use these increased resources towards providing immediate household needs.

Linking Child Survival Strategies with Environment-Based Primary Health Care Activities

Current child survival strategies have focused principally on decreasing mortality. Prevention from the primary health care perspective is limited to immunization, improved nutrition and the provision of micronutrients, the promotion of breast feeding and measures to decrease low birth weight, including child spacing. In recent years, additional importance has been given to the provision of better reproductive health services with specific family planning interventions aimed at child spacing and decreasing the overall population growth.

Population

Ethiopia has one of the highest rates of population growth in the world and one of the lowest rates of contraceptive usage. In all project sites visited, average family size was noted to be at least five with many being considerably larger. At the current rate of population growth, Ethiopia's population will double within the next 23 years. In a country with such marginal nutrition and agricultural vulnerability, the opportunity should not be missed to encourage child spacing and provide improved access to community and facility-based reproductive health services. Although SSI projects might, within their limited scope, improve household food security directly, unless population growth is lowered, there will continue to be an increasing food deficit in Ethiopia.

Integrated Management of Childhood Illness

With a global reduction of resources available for health sector development initiatives, there has been a move towards the integration of child case management. This has resulted in the Integrated Management of Childhood Illness approach (IMCI), which has been identified as one of the most cost-effective public health interventions.[36] In the past there have been separate case management schedules for acute respiratory tract infections and diarrhea. IMCI incorporates these and adds three important components: clinical management of malaria, nutritional assessment of each patient and assessment of the immunization status of every child. These strategies, however, do not attempt to address the environmental determinants of ill-health. There appears to be a clear opportunity associated with small-scale irrigation projects to also strengthen child survival programs by incorporating environment-based primary preventive activities as shown in **Figure 5.3.**[37]

Increasing Women's Participation

In examining relationships between causes of maternal and child ill health and nutritional status and survival, **Figure 5.3** depicts a conceptual framework. According to the framework, the root causes of poor child and maternal health relate to a more fundamental levels of control of household resources, gender roles and decision-making power, the household division of labor and participation in community organizations. It was noted during the field visits that in the majority of sites irrigation water user committees did not have a high women's participation, although women did figure more prominently in potable water users committees. The benefits of redressing this balance could be far reaching.

It would seem that the benefits accrued from small-scale irrigation projects could positively interact at a number of levels in this conceptual framework. If women have additional food to take to the market, household resources are increased. There is also increased household food security and diet diversity. Improved nutrient intake leads toward better health. It would, therefore, seem that small-scale irrigation projects and the direct benefits accrued provide an opportunity to promote gender equality, which would positively affect maternal and child health.

---

[35] Pelletier, D., **Relationships Between Child Anthropometry and Mortality in Developing Countries: Implication for Policy, Programs and Future Research**. Cornell Food & Nutrition Program, Monograph 12, 1991.

[36] Investing in Health, World Bank Development Report, 1993.

[37] Pelletier, D., **Options for Addressing Nutrition Problems in Ethiopia Through the Health Sector and Multisectoral Actions**. BASICS, USAID, 1994.

Leakage – A Regular Problem with Significant Impacts

Photos by T. Catterson

In the top photo, water leaking from the canals on this scheme was apparently trapped by a sub-surface impermeable layer, draining to a lowland below the site and causing water-logging of a once useful grazing area. In the lower photo, a dam built on fractured limestone; a very difficult foundation to waterproof.

Community Participation and Intersectoral Collaboration

Through the possibilities for intersectoral collaboration presented in small-scale irrigation projects, there are many opportunities to foster community empowerment. This empowerment will promote improved maternal and child health as depicted in **Figure 5.3**. Community education on the environmental controls of disease will have a positive effect on the community (as shown in **Figures 5.2 and 5.3**). It will also promote the concept of empowering a community to "draw-down" services (e.g., request for spraying, request for health services at village level) rather than waiting for services to reach down to the grassroots level.[38]

In practical terms, the above health-oriented discussion clearly illustrates the fact that really successful small-scale irrigation projects require intersectoral collaboration from planning right through to the operational and maintenance phases. Engineers involved in the design and construction of water resources need to be familiar with the health implications associated with irrigation projects. SSI extension programs, involving both agricultural extension agents and health personnel, need to include advice to women on the nutritional advantages and preparation requirements of vegetables and other non-traditional crops. Early in the planning phase, health workers need to ensure that there will not be adverse health impacts. They also need to work with all involved to institute environmental prevention activities within the community continuing through the operational and maintenance stages of the project. It would seem that the Water Users Associations set up for both irrigation schemes and for potable water could be excellent community level focal points for such SSI extension services.

Small-scale irrigation projects clearly offer opportunities to look holistically at improving household food security and the quality of food intake. They may also provide an opportunity to put into practice a paradigm shift in child survival activities which allow an additional focus on environmentally based prevention of diseases responsible for high morbidity and mortality. They also can provide a sound foundation upon which community empowerment can be strengthened.

5.3.7 Displacement and/or Changes in Land-Use Patterns and Social Equity

Establishing a small-scale irrigation system of any type, especially if it is a new scheme, will lead to land-use changes. Some of these changes, such as converting rainfed farming areas to irrigated plots, will be purposeful, socio-economically acceptable and, by definition, environmentally beneficial. They constitute an effort to optimize the productive potential of the area through the sustainable management of two important natural resources – land and water. Benefits notwithstanding, however, it is the unintended impacts that give cause for concern, namely those associated with displacement of people as a result of the construction, shifts in access to the irrigated land, disruption of downstream user access to water resources, and changes in food security and/or dietary habits of local people. It is an example of the basic question of "who pays/who gains?" that must be carefully examined and addressed in almost any type of development project.

Issue and Implications Statement

Although most proponents contend that there is a need for consensus in the community-oriented decision-making process, inequities can and do arise. The following actual examples were observed by the PEA Team during its field visits:

- **Displacement of farm plots as a result of SSI infrastructure construction**: Certain members of the community were obliged to give up their farm plots and/or grazing areas in order to make way for the construction of head works, canals and in particular, lands that would be flooded behind a earthen storage dam.
- **Rehabilitated and/or upgraded systems that shifted the command area**: Typically, an improved diversion system leads to the realignment of the canal system as part of the pursuit of greater efficiency in water use. Although this may make it possible to expand the actual area under irrigation, it is possible that a certain portion of the community may then find its lands outside the commandable area because the layout of the canal system shifts to accommodate the upgraded diversion weir or main canal.
- **Over-use of water in diversion systems depriving downstream users of their water rights**: Although this is presumably part of the planning associated with schemes of this type, the

[38] Promoting, enabling and empowering communities to "draw down" services is considered the best solution to the problem of the "top-down" approach to development. (personal communication, T. Catterson)

actual difficulties in measuring lean flow (discussed elsewhere in this report) and the potential for shortages in water supply, suggest that many such schemes over-use water and deprive downstream users of water for human and animal consumption and/or the possibility of establishing additional SSI schemes.

- **Tardy completion of scheme development delays the opportunity for compensation**: Because SSI establishment/construction works in large measure within the limited window of the dry season, and with a large labor force that must be attracted to the site with food-for-work, many schemes take several years to complete. This situation exacerbates the difficulties for those who have been displaced because the standard approach to compensation is to offer them land within the command area.

- **Changes in the household diet as a result of SSI and the preference for cash crops**: Food security will be enhanced if small farmers are able to produce cash crops, generate income and buy food. Unfortunately, this approach does not always work perfectly, with possible impacts resulting from marketing difficulties and gender differences.

Relationship with the Sustainability of SSI

Although the overall benefit of an SSI scheme may be overwhelmingly positive for the target community, difficulties mentioned above can jeopardize the entire enterprise. Inequities in allocation of the improved resource potential can lead to individual discontent, social conflict within the community and even to vandalizing or sabotage of the irrigation infrastructure. These types of issues may also lead to social conflict between adjacent communities with similar outcomes. Even if the situation does not become so exaggerated, brokering the community resolution of minor conflicts and issues increases higher management and administration costs which the proponent – the Cooperating Sponsor – will have to absorb.

Stage at Which Issue Arises

This is another example of an environmental impact which can take place at any and all stages in the development and implementation of SSI activities. It will, however, have its origin in the design stage, where, for one reason or another, the proper community understanding of water and land-use rights and responsibilities have not been thoroughly understood.

Detection and Monitoring

Beginning with and maintaining good dialogue with the community will be the most effective way to know whether user satisfaction is being achieved. Doing so calls for expanding and strengthening the capabilities of the Water Users Association so that they may effectively deal with community issues, both internal and external. As was mentioned above, it will be important to **maintain reasonable records of water use and stream flows, so that, should an issue of water rights emerge, the community has the information essential to analyze the problem and reaching a reasonable resolution**.

Suggested Mitigation Measures

One cannot and should not expect to achieve perfect social equity and justice on the basis of small-scale irrigation. There are simply not enough of these resources – irrigable land and available water – to go around. Also, by definition, only a modest portion of the food insecure population within a region, within a food insecure woreda, or within a community may be able to benefit from these development activities. Clearly, farmers and small-holders in Ethiopia already understand and live with these realities. They implicitly understand the dilemma of scarce resources – it is the pattern of rural life. It is also the reason why Title II programs offer a wide array of options in striving for improved food security.

Attempting to configure SSI so that all members of the community have a piece of land within the command area flies in the face of both existing land-use and land tenure patterns and negative attitudes about failed attempts at collectivization in the past.

What is not acceptable, however, are examples such as the above of situations of obvious injustice or inefficiencies which could have been avoided or otherwise mitigated. The following mitigation measures have been identified in discussions about these types of issues and difficulties:

- **Community participation and understanding of the scope of SSI**: During the design and planning stages, project proponents must be scrupulously careful not to overestimate the net available water or the size of the command area. Where the history of lean flow measurements is scanty, a conservative approach to planning irrigation potential is a must, along with a proactive explanation to the community about the possibilities and limitations over time. Starting modestly with projections of irrigation potential and building up capabilities incrementally should be the purpose of the first few years of operations.

- **Social norms and water user association rules**: With a proper start and a level of community understanding as mentioned above, the community will find it easier to enforce social constraints on unscrupulous behavior among individual user members and avoid over-using the available water and the impacts on downstream users.

- **Realistic compensation packages and their implementation**: The practice of compensating individual families for lands usurped in the development of an SSI scheme is already well-known and socially acceptable. Typically, compensation, as worked out at the community level, entails assuring space within the command area for those families that have given up their land for infrastructure. Timely completion of the development and implementation of the irrigation operations is key to making this approach work.

- **Well-planned cash cropping**: Ensuring that gender sensitivity has been taken into account in planning and executing cash cropping is of paramount importance, so that healthy family nutritional status can be maintained. Making this choice only after reasonable marketing premises have been established.

5.4 Anticipated Issues Which Did Not Emerge During the PEA

The Scoping Statement for this PEA identified a fairly substantial list of issues to be considered by the Team during its field data and information collection exercise. Most of the issues listed therein have been dealt with in this report, either as part of the discussion of environmental impacts or sustainability issues (to be discussed in the following section). In its consultations with the USAID Regional Environmental Officer, however, the PEA Team noted that some of what might have been anticipated as "likely" negative environmental impacts, did not emerge from its field review. In order to allay questions, and later doubts, in the minds of other reviewers and users of this report, the following section discusses some of these points and the reasons why they did not emerge.

Biodiversity Conservation Concerns

The Scoping Statement listed potential impacts on wetlands and biodiversity as important ecological issues. Although the biodiversity issue is one that would require significant additional resources to study, including the baseline ecological studies of the areas in question, the PEA Team did not raise it as an environmental issue for a number of reasons. On the one hand, it should be noted that the areas in which SSI schemes are being developed are far from pristine areas. Most of the Ethiopian highlands have been occupied by man for centuries, are now densely populated and the landscape has been dramatically altered with very few "natural" areas remaining as habitat for endemic or threatened species. None of the schemes visited involved natural forest areas; they are almost by design placed within existing agricultural lands – typically the bottom lands along a water course that have long been cultivated by man.[39]

The Team noted, albeit in passing, that some of the schemes may actually in fact lead to the restoration of natural forest cover because of the associated watershed management and catchment protection activities that accompany them. Doing so, particularly the larger plantation efforts or closure areas may actually bring back wild species. Whether this will be a positive outcome remains to be seen. In certain areas, an issue of wild pigs attacking home gardens has emerged because their populations are increasing as a result of the success of the community woodlots program which provide them shelter.

Although clearly, the establishment of a diversion system may lead to localized disruption of hydrology, this did not appear to be an issue because most plant and animal species of the arid and semi-arid areas of the Ethiopian highlands are presumably adapted to high fluctuations and occasional drying up of even perennial rivers. Encroachment on swamps and wetlands is a matter of scale; no large wetlands or protected aquatic areas were affected by the development of SSI in the areas visited. Indeed, such ecosystems are rare in the Ethiopian highlands. Nevertheless, in the future, it is suggested

[39] It is also important to note here that the Environmental Protection Authority of Ethiopia has recently published the **Conservation Strategy of Ethiopia**. Although this document discusses a need for a concern for preserving biodiversity, endangered species and otherwise sensitive ecological situations, the EPA is still in the process of preparing specific surveys and lists that would either categorize or register such areas or species.

that Cooperating Sponsors consult with Ethiopian agencies, such as the EPA and with the International Union for the Conservation of Nature (IUCN) about biodiversity concerns, and the possibility of endangered species or RAMSAR sites in new areas where they will be working.

Spate irrigation systems, taping the flood run-off from seasonal rivers was considered to have a potentially positive ecological effect as it would spread waters that might otherwise escape down the water course, onto the adjacent riverine lands. Most of these waters will be used for irrigation but inevitably, some will recharge the ground water and/or leak into adjacent small patches of riverine wetlands.

Blocking the Movement of People or Animals

Most of the SSI schemes visited are rather small in size (typically under 100 hectares and often much smaller, particularly in the areas being developed by the Cooperating Sponsors) and the long established nature of land-use means that there were already community sanctioned animal and human rights-of-way. Where access roads or pathways were needed to build and maintain a scheme, existing right-of-ways were often used for that purpose. Elsewhere, and as necessary, schemes built cross structures to allow for the free movement of people and their animals.

Land Tenure and Land-Use Conflicts

Although certain of the storage systems could be expected to generate conflicts with those interested in grazing their animals, the PEA Team did not observe that this was actually the case. In discussions with project proponents of the Cooperating Sponsors and other organizations, it was felt that although there were trade-offs in grazing areas flooded by reservoirs, the increase in the availability of water for the animals was considered by all to be an off-setting and very positive benefit. Although the PEA Team has not identified specific instances where land tenure undermined SSI sustainability, the issue is one of the most serious ones for Ethiopian farmers, who are concerned that they will once again be forced to redistribute lands. This overarching reality deters rural people from investing in improvements to the lands they are using, in all sub-sectors.

Overpumping of Groundwater

The only lift systems observed were those using the water from perennial rivers, lifted on to an adjacent crop lands by the use of motorized pumps. No tube-well-based SSI schemes were observed and none are planned by the Cooperating Sponsors.

Pesticide Use

Although pesticides are being used in many SSI schemes, the amounts and actual use is extremely limited. Furthermore, these pesticides are not being provided to the farmers by the Cooperating Sponsors who are sensitive to the issue of pesticide use and the USAID regulations put in place to regulate them. Over the medium to long-term, however, and in order to achieve the full intensification of agriculture that SSI makes possible, improved availability of pesticides and their use, handling and storage may make it incumbent on the Cooperating Sponsors to undertake an assessment of these agrochemicals and train their staff and the Development Agents in sound practices of pest control. A number of the Cooperating Sponsors have already included notions of integrated pest management (IPM) and integrated fertility management (IFM) into their extension programs.

5.5 Cumulative Impacts

The PEA methodology of environmental review is not well-suited to a consideration of cumulative impacts, mainly because such an analysis would be entirely speculative. The possibilities and probabilities for cumulative impacts are technically part of an environmental assessment of a specific project or activity in a specific site where the chain of effects can be more easily foreseen. Thinking about and being concerned with cumulative impacts is, however, well worth some attention.

This PEA has made the point, in several ways and from several perspectives – environmental, social and economic – that SSI is more likely to be successful if more attention is given to it as a system rather than as a set of irrigation infrastructures, linked from the upstream catchment to the downstream users. For example, failure to deal with the degraded condition of a catchment can have catastrophic and cumulative impacts on the remainder of the scheme. Diminished water resources, increased flooding and higher silt loads will in turn make rational water management for the users more difficult. This will increase the probabilities of erosion, salinity, water-logging and the occurrence of disease vectors. Each of these effects will have an impact on the overall goal of increasing agricultural productivity and undermine the achievement of the expected results of food security. Regrettably, such instances of cumulative effects on individual sites tend to be more common than most proponents of SSI would be comfortable with accepting.

As development efforts continue and expand across the length and breadth of the highlands, Cooperating Sponsors will have to look more carefully at what other projects (those of their own, of other CSs, of other donors and the Ethiopian Government) exist in areas where they intend to work and how these interventions will fit together. There could be opportunities for synergistically positive effects on the environment or the danger of more harmful ones. Oversight of this nature would appear, however, to be especially well-suited to the responsibilities of the Regional Commissions for Sustainable Agriculture and Environmental Rehabilitation. It would be benefit all concerned if the CO-SAERs could inculcate the ideas of holistic environmental management on an area or catchment basis as part of their approach to their mandate for environmental rehabilitation and sustainable agriculture.

Table 5.4: The Environmental Impacts of Small-Scale Irrigation–Ethiopia

Negative Environmental Impacts	Specifics	Stage at Which It Occurs	Causality	How to Detect or Monitor	Mitigation Measures	Relationship to Sustainability
INEFFICIENT WATER USE						
Water Losses during Transport		Construction Operations	Poor design and construction	Visual inspection of system... wet spots or leakage occurring along the primary canal or below the micro-dam	Improved design and construction and timely maintenance and repair of system components	Inability to satisfy full demands for irrigation w/i the command area and consequent user dissatisfaction
Water Losses during Transport		Construction and Operations	Seepage in unlined canals	Same as above	Extending the length of lined canals	Same as above
Poor irrigation water management		Operations	Farmers unaware of irrigation regimes/crop water requirements	The emergence of salinity or waterlogging problems; discussions with farmers; social conflicts and/or the inability to irrigate the full command area	Careful analysis of irrigation water availability, analysis of crop water requirements and training of DAs and farmers	Same as above
SOIL FERTILITY AND QUALITY MAINTENANCE UNDER INTENSIFIED CROPPING SYSTEMS						
Soil Salinity Problems		Operations	Over-Watering, Poor Quality Irrigation Water, High Water Table, Saline Soils,	Visual evidence of salt appearing on surface, soil tests	Proper Irrigation Regimes and Farmer Training; Adequate Drainage Measures	Restricted Crop Productivity or Limitations to Crop Choice; poor returns to farmers
Water-logging		Operations	Over-Watering, Seepage, Poor System Design and/or Field Leveling, Lack of Drainage	Visual evidence of wet spots occurring within the scheme or in adjacent areas	Proper Irrigation Regimes and Farmer Training; Improved System Design including Drainage Where Necessary	Restrictions on plot productivity; loss of productivity of adjacent areas; poor returns to farmers

Table 5.4: The Environmental Impacts of Small-Scale Irrigation–Ethiopia (continued)

Negative Environmental Impacts	Specifics	Stage at Which It Occurs	Causality	How to Detect or Monitor	Mitigation Measures	Relationship to Sustainability
SOIL FERTILITY AND QUALITY MAINTENANCE UNDER INTENSIFICATION CROPPING SYSTEMS						
Soil Erosion		Operations	Slopes beyond 5% in command area and lack of soil and water conservation; over-watering	Visual evidence of soil transport within the command area	Proper choice of command area; field leveling within command area; soil and water conservation structures; proper irrigation regimes	Losses in productivity; higher canal maintenance requirements and increased labor
Depleted Soil Fertility		Operations	Over-intensive use of plots without soil fertility maintenance and enhancement	Monitoring of crop yields	Fertilization, crop rotation, inter-cropping, fallow and green manure crop	Declining crop productivity and low returns to farmers
WATER RELATED DISEASE HAZARDS						
Increase Incidence of Water-Related Vectors and Diseases		Construction Operations Maintenance	Stagnant water; poor maintenance of canal structures; inappropriate site use	Visual evidence; changes in baseline health indicators	Avoidance of stagnant water or contact with irrigation water, as possible; parallel attention to potable water supply; training and human behavioral modification	Significant impacts on social welfare; reduced capacity to assimilate the benefits of improved nutrition thereby eroding food security gains
Human Use of Irrigation Water		All stages	Lack of alternative potable water supply; inappropriate human behavior	Same as above	Provision of alternate sources of good quality drinking water as part of the scheme; training and human behavioral modification	Same as above

Table 5.4: The Environmental Impacts of Small-Scale Irrigation–Ethiopia (continued)						
Negative Environmental Impacts	**Specifics**	**Stage at Which It Occurs**	**Causality**	**How to Detect or Monitor**	**Mitigation Measures**	**Relationship to Sustainability**
DISPLACEMENT AND/OR CHANGES IN LAND-USE PATTERNS						
Impacts on Downstream Users		Construction Operations	Failure to measure net water availability correctly; over- abstraction of water	Dialogue within and among the communities	Proper calculation of net available water; modification of irrigation regime; within community social norms and user association rules	Social conflict among and within communities; food security losses for non-beneficiaries; higher management and administration costs.
Inundated Farm and/or Grazing Lands		Construction Operations	Need to relocate irrigation infrastructure or to flood lands in use	Monitoring agreements related to land redistribution or compensation; dialogue with the whole community	Compensation; land redistribution; timely completion of the activity so as to diminish losses	Social conflict within communities; losses to individual families; compensation claims leading to higher costs
Food Security/Dietary Impacts		Operations	Preference for cash crops over food crops; gender differences not accounted for	Nutrition baseline and follow-up surveys; inter-gender discussions; and observations	Ensuring gender sensitive crop pattern planning; marketing mechanism in place	Negative impact on the achievement of the overall goal of the activity – and reasonable food security

6. Sustainability Issues Associated with Title II Funded SSI

It is important to bear in mind that ideally one applies environmental review to activities that are expected to be reasonably effective and efficient in achieving the results for which they were designed, which in the case of Title II programs is to achieve improved food security. During an environmental assessment, however, it is far more common than many may understand, to identify other issues which may be contributing to negative environmental impact but which, with clear analysis, are found to be more directly related to the feasibility or sustainability of the activity being scrutinized. One does not "mitigate" mistakes; one avoids or corrects them.

That small-scale irrigation for food security enhancement is challenging should not be surprising. SSI is the most complex and technologically and socio-economically demanding option currently being undertaken by the Cooperating Sponsors in their quest to have an impact on food security in rural Ethiopia. Similarly, few would argue, that within the agriculture sector, irrigated agriculture has proven to be the least sustainable approach worldwide. More land is going out of irrigation each year than can be developed for irrigation, precisely because of the difficulty of planning and executing sustainable schemes.

The issues ("lessons learned") mentioned here were identified as the result of observations and dialogue in the field. In all cases, there were recurrent examples; individual cases or extremely localized issues were not included in this list. In part, and by its very nature, a program level assessment and, in particular, one focused on the environmental dimensions of a development activity, were bound to lead to findings such as those which follow. Looking at things from an "environmental" perspective forces one to see things holistically and connect cause and effect.

The findings which follow should not be considered comprehensive nor is the discussion particularly exhaustive about the issues, however, as this exercise was an environmental assessment and not a program level evaluation. The PEA Team is convinced that taken as a whole these feasibility/sustainability issues are sufficiently disquieting so as to merit real scrutiny and a concerted effort at responding to these serious questions and identifying remedial actions by both the Cooperating Sponsors and USAID/Ethiopia.

The PEA Team was encouraged to raise these issues for two reasons. It is well aware of the conviction among the Cooperating Sponsors and their staff who are keen to move "Beyond Compliance" and increase the effectiveness and efficiency of their programs. Secondly, the rather forthright assessment of the performance of the Water Sector in Ethiopia, as discussed in the recently (1998) released Comprehensive and Integrated Water Resources Management Policy papers prepared by the Ministry of Water Resources, challenges all concerned to improve the quality of sector programs.

6.1 Policy, Programming and Planning Issues

In the inevitably more general discussions about SSI with the field staff of the Cooperating Sponsors, this PEA gave rise and voice to a number of over-arching concerns, related to the nature of the Title II program itself. They included:

6.1.1 SSI Potential in Food Insecure Woredas

Many proponents acknowledge that the bio-physical and socio-economic circumstances (drought-proneness, rugged topography, high population density and geographic isolation), which create the conditions for food insecurity, also limit the place of SSI. Respondents questioned about the total area that could be brought under SSI in these woredas estimated a maximum of five percent as potentially irrigable.[40] However large or small this potential for SSI, decisions about its place with the food security programs of the Cooperating Sponsors should perhaps best be based on an understanding of the percentage of program resources it absorbs (against

[40] Speculation on the potential applicability of SSI in the food insecure woredas of the country is all that is possible at the moment. No study was identified that looks at the issue of strategic placement and program emphasis for SSI. This could be one of the topics to be considered under the present policy and program initiative related to the water resources sector currently being undertaken by the Government and the Ministry of Water Resources.

the number of beneficiaries) and certainly in terms of its requirements for critical staff time.

6.1.2 SSI and Its Fit Within the DAP Approach

The amount of advance data and information collection and community involvement in planning may not be fully compatible with the five year time frame of the DAP/PAA approach. It has been suggested that in order to be certain of the feasibility of SSI on a given site, a minimum of two years advance efforts may be essential. Does that imply that SSI activities can only start in the third year of an approved DAP? Similarly, experience has demonstrated that the larger undertakings – diversion systems and storage systems – despite their "small-scale" nature, require several (one to three) years to complete. Furthermore, this PEA has recommended the need for a purposeful start-up phase to implementation, lasting up to three years, during which time considerable staff resources (albeit with much less food aid) will be used while working with the Water Users Association and the communities to fine-tune the workings of the scheme. Could/should this be a responsibility of the Cooperating Sponsors? The PEA Team believes such should be the case. Can this start-up phase be accommodated within the DAP approach and if so, how so?

Yet others have raised the issue of SSI choices being motivated by the need to show "results" and to do so in a relatively short time frame consistent with the new performance monitoring system put in place to account for the re-engineered relationship between USAID and the Cooperating Sponsors. Has SSI been perceived at higher levels (USAID, Government of Ethiopia and PVO Headquarters) to have greater, or more, easily quantified impacts and results – the classic "water blindness syndrome"? Similarly, it is too difficult to carefully broker the decisions within the target communities without raising expectations that might not be met.

One of the responses to this particular set of issues is the "area development" or "catchment" approach to overall programming wherein a Cooperating Sponsor concentrates efforts both geographically and programmatically. Certainly, much of the data and information collection efforts could be eased if one was working in adjacent areas where conditions were similar. Then too, having a demonstration site nearby and a committed community that understands its rights and responsibilities could accelerate the learning on the next adjacent community site through purposeful efforts to share the experience.

6.1.3 The Present Water Resources Policy Initiative and Title II

In the last few years, much of the promotion and development of SSI in Ethiopia has occurred through the Title II program. The substantial experiential base and skills of the Cooperating Sponsors is a profound resource that should be tapped for the present national dialogue on a coherent water resources policy. To date, the Cooperating Sponsors have not been invited to participate in this debate. The Ministry of Water Resources' "White Papers," prepared to guide the policy debate, have offered a very forthright analysis of the problems within the sector and opened the door to critical thinking and further analysis of the options, based on a sound understanding of hard-won field experience.

Then too, many of the present SSI schemes should be seen, as suggested by REST, as pilot exercises, bound to provide the background for important future policy and program decisions. Indeed, the PEA Team is convinced that one of the most important outcomes of the present array of programs may be the "lessons learned." It will also be important to maintain and acknowledge what "does not work" lest one repeat the mistakes of the past. USAID should do everything possible to encourage the Cooperating Sponsors to learn from the past and should approach the Government and the Ministry about utilizing this rich data source for the policy dialogue.

6.1.4 Moving Environmental Considerations to the Field

The Initial Environmental Examinations (IEEs) presented with the FY 98 DAPs were the first formal occasion for the application of Reg. 216 to Title II programs in Ethiopia. In the main, they were relatively well done and showed an appropriate understanding of the procedures, demonstrating a willingness to fulfill these requirements on the part of the Cooperating Sponsors. The PEA Team noted, however, that in all cases, as might be expected, this environmental documentation was prepared at the headquarters level in Addis Ababa. In some cases, field staff were not even aware of the process.

The Team is convinced that in order to encourage early adoption of more environment-oriented planning for all activities, the responsibility for preparing the IEE should be moved to the field. In the case of SSI, it will only be the field staff who will be fully able to correctly execute the Environmental Planning Checklist (see Section 7.2 below) that will be at the heart of future IEE submissions for SSI. Doing so will be a *prima facie* case of going "beyond compliance" because the checklist is designed to elevate environmental considerations to their proper, early place in the planning cycle, ideally leading to fewer negative environmental impacts and greater program sustainability.

6.2 Economics of Small-Scale Irrigation

Lest there be any misunderstanding, the section which follows is not proposing that economics be used to decide whether to help hungry people to feed themselves, but rather how best to do so.

6.2.1 Place of Economics in Food Security Programs

Although many project personnel and SSI proponents seemed conversant with the concepts of cost/benefit analysis, the PEA Team was unable to identify a single instance where it might have been realistically applied to the planning process associated with a given scheme. At best, respondents could speak generally about the basic costs of the activities and, occasionally, about the mean cost per hectare of irrigated land. Others sometimes alluded to indicative cost figures for SSI; 35,000 Ethiopian Birr per hectare of command area under storage systems, 15,000 for diversion systems. It was later learned that these figures are from an outdated FAO (1974?) publication. No up-to-date analytical report on the cost of SSI could be identified for Ethiopia. Where cost data were available, there were instances where the average cost per hectare of irrigated land was many times (as much as three to five times) higher than these so-called standard costs. How then can economics be applied to Title II funded SSI?

6.2.2 Applying Economic and Financial Analysis to SSI

The scope of this PEA exercise precludes an in-depth examination of the notions of applying these techniques to SSI. The Team was also unable to collect all of the essential data needed for a full-scale treatment of the subject. This does not mean that these topics are less important. On the contrary (and recalling the caveats above about not applying strict economic analysis to the social dilemma of hunger or attempting to compare alternative sites), the PEA Team is convinced that further clearer thinking and analysis about the economic dimensions of SSI would assist in improving both the ability to replicate these activities from one site to another as well as the sustainability of the activity in general. There are a number of ways to apply these techniques that could be instructive; they include:

- **Examining the economic feasibility of SSI as an enhanced food security option**: Will the total cost invested in SSI lead to equal or better returns in terms of enhanced food security per beneficiary as compared to other options, such as improvements to rainfed farming through soil and water conservation or improved farming systems. These are extremely difficult calculations to make and not necessarily something that should be performed in every instance. One would expect, however, that growing experience with development oriented uses of Title II resources among the community of Cooperating Sponsors (and others – the CO-SAERs) would lead to **an understanding of the relative costs of different food security enhancement options** over time. The outcome of an analysis of this type might also take into account the costs of staff time for different options; SSI seems to be an activity which is more demanding in terms of the staff time required to put the scheme in place. This is an important consideration for any organization that must consider how to use its limited institutional resources most effectively when dealing with a very large problem.

- **Analyzing the economic feasibility of a particular SSI site**: Classic micro-economic analysis of a proposed investment, i.e., will the returns to the investment be equal to or better than its costs. There are **a number of approaches** to this analysis, including: **net present value (npv), benefit/cost analysis (b/c) or the calculation of an internal rate of return (irr)**. Anyone using these techniques, however, should also take into account the social benefits, however difficult to quantify, of avoiding malnutrition or worse, migration and household disintegration. Food security problems add effects that mean other social costs for the family, the nation, the government and/or its donor partners. One could carry out such an analysis for the whole undertaking in a given site and decide if it is a viable investment, something which becomes particularly germane if the farmers have had to contribute tangibly through co-financing or by taking out a loan. Deciding on which cost and benefit factors to include or exclude may be a challenge; doing so, however, implies stating the assumptions clearly. For example, where cash crops are involved, the distance to the market town and the condition of the road will affect transport costs and thus the selling price.

- **Analyzing the marginal returns to system design and operations**: Economic analysis can help in **making the final choices about the size of the scheme or the utility of different options and their outcome**. For example, would the cost of lining the primary canal be financially effective in terms of production increases? This type of analysis is also closely related to an ability to understand and quantify a breakdown of cost components of different systems. This understanding could assist the community and CS in achieving cost savings.

- **Analyzing the financial implications for the individual farmer**: Overall, a scheme may be economically feasible but an individual farmer, because of different production capabilities related to the size and quality of his/her land, could have difficulties. Such an analysis would **examine the farmer's costs** (including annual operations and maintenance costs as part of the collective, and seasonal production costs) **against the returns** in terms of improved production or food value (or cash crop earnings). Here again, it would not be necessary to carry out such an analysis for each farmer; it would be preferable to build up a table based on experience in the highlands with SSI that might index plot size, crops and location (or some other variables).

- **Valuing environmental impacts**: Although it may be premature to apply such concepts to environmental concerns in the highlands, it will certainly be a topic of importance in the new millennium when well-being will be defined in terms of access to a clean environment and adequate supplies of natural resources. There is already some sense of these values in social perceptions and government policies and programs about potable water supplies which would probably prevail if a choice had to be made with water for irrigation purposes. These environmental values can also be positive. For example, in order to maintain water supply, a community must give attention to watershed management or catchment protection.

- **Keeping records – financial and otherwise – of scheme operations**: The ability to analyze these economic and financial dimensions of the system depends on the availability of a quantitative record. Maintaining these records and using them can assist the user group in understanding how to respond to issues and problems by facilitating a quantitative analysis of cause and effect. Doing so may add to the transparency of sensitive issues and strengthen the basis for collective action on which irrigation depends. These same records can provide an essential backdrop to cover multiple objectives: basis for a water user fee system for operations and maintenance; basis for valuing water as a scarce resource and promoting conservation attitudes among the farmers; and facilitation of farmer analysis of particular crop choices or agronomic practices.

6.2.3 Food aid, Food-for-Work and Small-Scale Irrigation

Under the present world situation of constrained resources for food aid, the Cooperating Sponsors need to think carefully about these resources in terms of investment strategies and changing circumstances. Would the current SSI development models be replicable without the availability of large amounts of food aid?[41] If SSI projects had to be fully funded with cash and if cash-for-work was used to subsidize the hiring of external labor, what would be the impact on the program? Almost all of the SSI development currently taking place in Ethiopia, including much of that being promoted by the CO-SAERs, includes substantial amounts of food aid provided by the World Food Program.

6.2.4 Thinking in Whole Systems

In a number of instances, the PEA Team noted that SSI development was almost exclusively focused on the operations associated with constructing the head works and primary canal. The intended users were expected to construct secondary and tertiary canals themselves. Only rarely did field staff attribute the costs of these further developments and the costs of access road construction, catchment protection/rehabilitation or companion potable

[41] Traditional SSI has, in many instances, been constructed without government intervention or assistance although it has been relatively small in scale. Farmers may indeed be motivated by the promise of additional productivity to undertake all the labor involved on their own without food aid. Moreover, it is important to recall that many of the schemes promoted by the Irrigation Development Department of the Ministry of Agriculture – some 72 schemes built up to the period 1992/93 – did not use food aid.

water to the specific budget of the scheme, arguing that this would increase the costs substantially. Although these additional activities will certainly add substantial costs, they also bring tangible and quantifiable benefits and are often critical to the avoidance of negative environmental impacts and to the sustainability of the scheme. This relatively shallow concern and understanding of costs and benefits may be institutionalizing weaknesses or future problems that will completely undermine the supposed internal rate of return for the scheme.

6.2.5 Economies of Scale in SSI – A Contradiction

Are schemes being designed with larger than feasible command areas in order to justify the capital costs of the major head works and primary canal? Does that not, in effect, translate into much higher unit costs for the actual development of irrigated land when the full command area projections cannot be reached? Is this situation being taken into account when considering the economic feasibility of SSI? Is the basis for planning "best case" scenarios or "worse case" scenarios; which make more sense and why? What are the implications for water user associations in terms of operations and maintenance of expensive head works and canals that serve too few users? And finally, does this problem of overly large and capital intensive infrastructure construction waste scarce cash resources that could be used for greater impact on food security achievements elsewhere for a larger number of beneficiary households or with another strategy option?

6.3 Dilemma of Poor Hydrological/ Meteorological/Water Resources Assessment Data

Almost everywhere, SSI activity designers and planners are faced with a lack of good data on the hydrology of the stream/river system that will be their water source and on the local weather and climate conditions.

6.3.1 How Much Water is Available for SSI

Stream gauging stations are virtually non-existent in remote rural areas of Ethiopia; they have been installed only on major rivers. Meteorological stations are almost as rare. While there are several surface water assessment methods and formula, none of them work in the absence of reasonable data.[42] Somewhat surprisingly, most of the Cooperating Sponsor engineering staff seem unable to explain adequately how they cope with this fundamental issue. Most are obliged to design SSI systems on the basis of a very limited number of measurements of "lean flow" taken over one or two years, at best. Similarly, water level gauges seem to be absent in most storage reservoirs. Although staff had some understanding of the relationships between water levels and potential commandable area, without the data it is impossible to carry out reasonable annual planning.

6.3.2 Convention, Conservation and Conservative

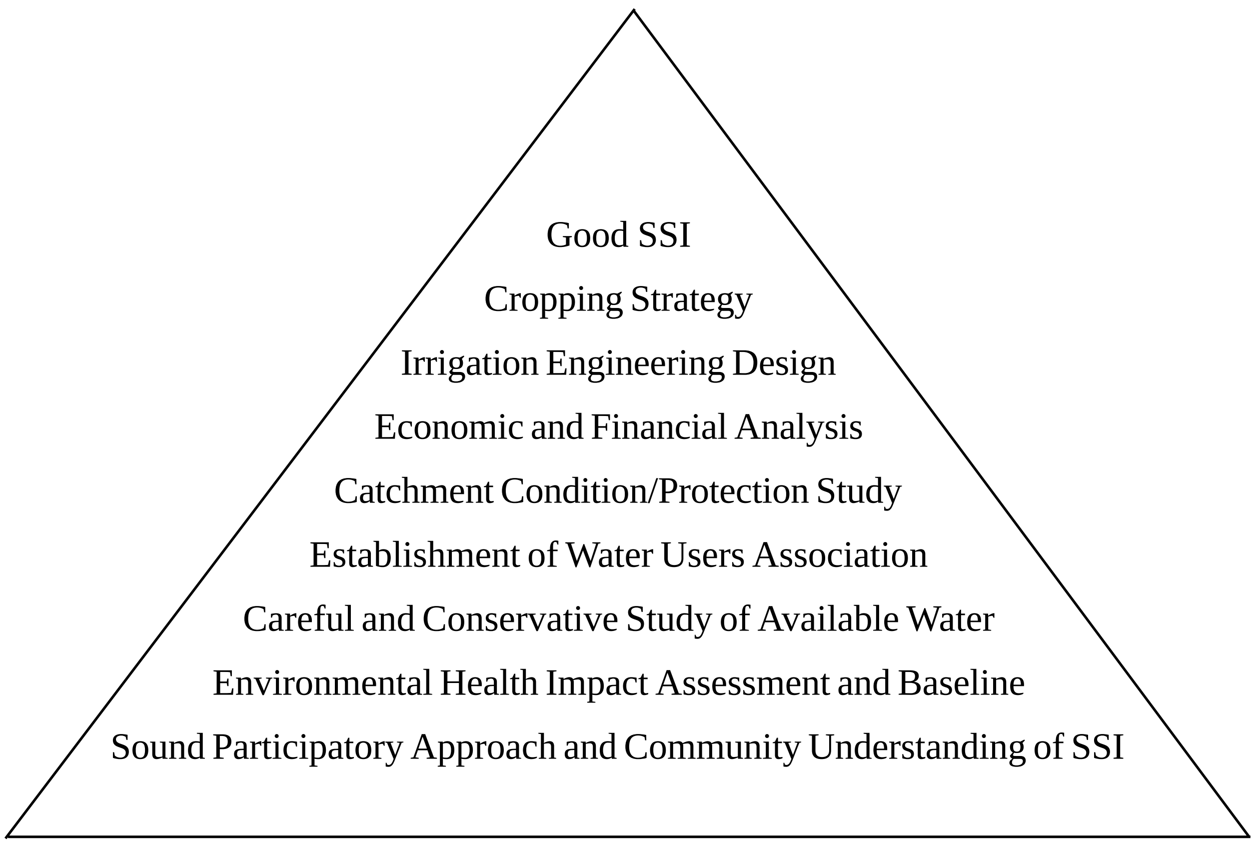
The formulas for determining total surface water availability, presuming reasonable data, would then, by convention, be reduced according to a range of factors to determine net availability for SSI. By convention as well, most manuals on irrigation hydrology suggest the use of the 80 percent rule, reducing calculated net water by 20 percent to build in a margin for error. This rule is intended to account for the vagaries of weather. In the highly erratic rainfall zones in which these Title II programs are operating, and given the often degraded condition of the catchments (which makes the situation worse, leading to bigger floods and smaller lean flows), a more conservative approach to water resources assessment might be a wiser choice, applying a greater reduction of estimated net water (the 20-30-50 percent rule?).

6.3.3 Aggravating the Uncertainties

SSI schemes operating on the basis of uncertain data regarding water supply will be more severely affected by any losses to net water availabilities, including leakage within the system, evaporation from surface waters (of particular concern with reservoirs) and a poor grasp of proper irrigation water management by the DAs and the farmers. Maximizing the size of the command area or the number of households that can be accommodated, means minimizing the use of irrigation water. Perhaps logically, but also unfortunately, there seems to be a tendency towards optimistic assessments of net water supply for irrigation akin to the tendency mentioned above to build larger schemes to justify the costs. These tendencies are inimical to the need to emphasize the value, wise use and conservation of this precious resource and means that projects start off on the wrong foot.

[42] The ESRDF **Technical Handbook for Small-Scale Irrigation Projects**- Component IV, in its section on headworks and irrigation system design, describes four different methods: statistical method, hydrological analogue method, SCS (for Soil Conservation Service of the U.S.) method, and the regionalization approach. Some of these are thought to be well-suited in the case of ungauged catchments but all require local meteorological data which is almost as rare as stream gauging data.

Figure 6.1: Promoting and Developing SSI on a Firm Foundation



6.3.4 Measurement, Catchment Protection and Incremental Construction

Cooperating Sponsors will have to take a proactive posture to deal with these issues of water supply assessment and availability; otherwise they will remain the "Achilles' heel" of SSI. Any such project should start with the installation of a simple stream gauging station that allows for measurements on a regular basis. A local farmer leader and someone who is likely to be part of the water users association could be trained and charged with taking the measurements, both before construction and after the scheme has come on line.

Where catchments are degraded, an effort at protection and rehabilitation should be seen as a prerequisite to building an SSI scheme. Too often, as alluded to above, catchment protection is seen exclusively as a cost. Improved upper catchments, in addition to providing a more regulated flow of water for irrigation, can also produce tangible outputs – firewood, fodder, fruit, medicinal plants, fiber and thatch – that can be managed and harvested on a rational basis. The expanding experience with closure areas being pioneered in many parts of Ethiopia also offer a lower cost option for catchment management and protection.[43]

Finally, the Cooperating Sponsors should explore the option for incremental construction of SSI schemes, starting small and adding on to the canal system and command area as experience with water availability accrues. Such an approach implies a genuine and realistic dialogue with the community but builds on their inherent understanding of risk aversion strategies for coping with unreliable rainfall. It also is more congruent with the typical social norms of food insecure rural communities in the Ethiopian highlands whose approach reflects the need for spreading risks, avoiding social conflict, achieving local control and the redistribution of resources.

6.4 Enhanced Community Participation – a Development Objective

Traditional irrigation practice is an old art in some parts of Ethiopia. By definition, the act of irrigation, whether formal or informal, is characterized by group interactions associated with human behavior. Accordingly, there are many versions of localized organizations that have developed around the country – in Gojam, *yewuha abat*, in Hararghe, *aba meleka* and in Tigray, *abo may* – all of which mean "father of the waters." Although their operations reflect the physical and social environment in which they exist, they all perform more or less the following functions: mobilizing local resources, distributing irrigation water per an agreed schedule and resolving conflicts among users. As these traditional schemes are organized by the communities themselves, without external assistance, participation is self-mobilized and all irrigation issues are handled by the farmers themselves. Where they already exist, these local organizations might offer a better choice for participatory development – strengthening the existing organizations rather than creating a new project driven model.

Within the new schemes being developed by the Cooperating Sponsors (and all the other organizations working in SSI), the conventional model for community organization and participation is the water user committees or associations. Although similar in intent to traditional approaches, these new organizations seem relatively weak (and are so described by many proponents). Most have been imposed on the community and are only formed after the completion of the scheme. The water users committees also manifest a surprising uniformity in size (usually five members) and similarity in function (mostly labor mobilization), which is in sharp contrast to the diverse nature of the sites, schemes and communities involved in SSI. Participation appears to be functional, organized by the external agencies to meet predetermined operational needs of the scheme.

6.4.1 Participation – the Hardest Challenge of All

The present low level of genuine participation – whether at the community level or among the users (the reader will note that the distinction is both valid and important) – and the proliferation of organizations involved in most schemes, suggests that the present situation is both "top-down" and "top-heavy." SSI was one of the development responses to the concern about food aid

[43] See also the many recommendations and suggestions for improved approaches to natural resources management contained in the 1994 publication: **Natural Resources Management and Title II Food Aid: An Evaluation** by Catterson et al, prepared for USAID/Ethiopia.

Figure 6.2: What Goes Around, Comes Around, and Pays Off

dependency; program dependency can be just as bad. Irrigation is by definition a "social act." Those seeking to promote and develop it will need the right mix of skills and attitudes able to address both its technological and community dimensions. Community organization will be the focal point for brokering the realities about scarce resources and the social consensus that defines irrigation – sharing the water and the rights and responsibilities associated with managing it effectively and efficiently. It is also clear that the views and roles of women will need much more attention if SSI is to become a real household food security strategy option.

6.4.2 The Base of the Pyramid

Community understanding, planning and decision-making will be the bedrock on which to build sustainable small-scale irrigation systems. It will be as or more important than the correct assessment of net available water, another element of the foundation. There is presently too much emphasis on building the head works and the main canal and not enough on the social structures – the water users association that will have to use and maintain the scheme. Community and user satisfaction are key ingredients in ensuring a realistic commitment to sound operations and maintenance and being able to reach consensus on sharing water rights and responsibilities. Community participation is also essential to finding out about the real environmental impacts, those with impact on the human environment that often are difficult to measure technocratically. The PEA Team views community participation as the foundation stone of the pyramid of prerequisites to successful SSI – with sound water resources assessment and catchment protection and rehabilitation – and the trigger to a decision to go ahead with the construction of the infrastructure.

6.4.3 A Strategy for the Development of Community Participation

Adding this " foundation stone" – genuine participatory management capabilities – to a functional Water Users Association or Committee should be one of the defined and measurable objectives of SSI development. Communities should play a profound role in SSI planning and implementation. There are decisions that should only be made with the full agreement of the community, including: size of the command area, number of farmer households that can be accommodated, its relationship with previous community irrigation, the average size of the irrigated holdings, the overall crop and cropping pattern, and expectations about annual needs for inputs and likely outputs. Too often, in the course of this PEA, field staff espoused a need to "change the farmers" or "convince them to do" something. In actuality, what is required is to empower the farmers, building community capabilities to "draw down" the services which they need and have a right. "Draw down" is the only response to the age-old problem of "top-down."

6.5 Institutional Compartmentalization and the Institutional Framework for SSI

The "blinding promise" of SSI is leading to political and organizational myopia in which too many organizations want to get involved and get the credit for establishing schemes. These organizations usually, and regrettably, only actually build the headworks.

6.5.1 Institutional Responsibilities and Accountability

One of the recurrent dilemmas that the PEA Team noted in its analysis of SSI, was the persistent use of the phrases "going to be done" or "is being planned," often in combination with allusions to the fact that the next steps were expected to be carried out by some other unit or organization. Taking credit for establishing such schemes does not seem to be accompanied by a willingness to be "accountable" when there are difficulties. This lack of accountability, born of an irrational compartmentalization of responsibilities associated with the current institutional approach to SSI, is regrettably, in the view of the PEA Team, leading to institutionalized mediocrity in the performance of the sector. It is the antithesis of the type of selective program integration that will be required for really effective, efficient and sustainable SSI schemes.

6.5.2 Consolidating Capabilities

At present, and apparently because of a seemingly rational government policy concerned with maintaining an institutional presence after the Cooperating Sponsors withdraw, there is a predetermined separation between those responsible for planning, building and operating a scheme. While the Cooperating Sponsors are expected to interact with a variety of Regional Government Bureaus during planning and design, the real role of these latter organizations comes into play once the primary infrastructure has been built and the scheme turned over to the communities. At least three regional bureaus are expected to play a role in assisting the water user committee to manage the scheme, including: Agriculture, which will provide the extension agents (DAs); Energy, Mines and Waters, which is supposed to assist the community in maintaining the headworks and primary canal; and Health, which is supposed to aid in the control of vector related diseases. In addition, the woreda council must also be called upon to sanction any decisions related to land redistribution. There are probably other organizations as well which might be called upon to intervene in the operations and outcome of an SSI scheme.

Despite its good intentions, a number of issues arise with this scenario. There is a propensity to create more "bosses," who, no matter how well-intentioned, are the real threat to participatory development. Each of the above regional bureaus defines its role in terms of its authority over the schemes in its area, and not in terms of the services it will provide. This definition of authority is part of the growing pains of the transition to federalism and decentralization, recreating overly centralized government on a geographic basis. This approach will also present an enormous challenge to regional governments and its bureaus because, in contrast to the relatively well-funded organizations establishing SSI schemes, such as the Cooperating Sponsors, the CO-SAERs and several funding mechanisms, regional governments must compete for staff, transport and budgetary resources. The first of these – trained staff with specialized skills and experience with SSI – will be both hard to come by and hard to keep. Coordinating the allocation of resources for activities that take years to put in place will also be difficult for regional governments to reconcile with their own programs.

Water – A Little Goes a Long Way

Photo by T. Catterson

This small garden – about one quarter of a hectare in size – was being watered by the overflow from a potable water supply tank built by one of the Cooperating Sponsors on the owners land. Needless to say, he felt the trade-off, ceding a small piece of land on an otherwise barren hillside, was well worth it. There are probably more such opportunities for synergism with potable water supply and SSI.

7. Practical Guidance/Tools for Environmentally Sound SSI

7.1 The Context for this Guidance and Tools

The reader will recall from the previous discussion that this programmatic environmental assessment of small-scale irrigation was intended to provide some practical guidance to the present constraints associated with Reg. 216 and the fact that it mandates a Positive Threshold Decision and a subsequent Environmental Assessment for all irrigation activities funded with USAID resources without qualification. Although it is not within the purview or authority of this PEA to change the rules, it was recognized that requiring full scale environmental review for all Title II-funded SSI, the scale and impact of which is typically minor, would be an unnecessary burden for all concerned, both Cooperating Sponsors and USAID personnel.

This chapter thus presents "guidance" and tools that will ensure that environmental concerns regarding small-scale irrigation are taken into account in an effective manner in the design, planning, construction and operation of SSI schemes. It reviews a series of scenarios for how environmental review within the framework of Reg. 216 will be applied to future SSI developments in Ethiopia. Procedurally, it is expected that this report, and more specifically the recommendations in this chapter, will be reviewed and commented on by the Cooperating Sponsors. Then, USAID Environmental Officers, including the USAID/Ethiopia Mission Environmental Officer and the BHR Environment Officer will also scrutinize and officially approve the recommendations herein on the Environmental Review Process for Title II- funded Small-Scale Irrigation. The following scenarios and the "guidance" associated with them, are foreseen:

- **Responsibility for Preparation of IEEs**: The preparation of the IEEs will continue to be the responsibility of the Cooperating Sponsors who will submit them to the USAID/Ethiopia Environment Officer. The presumption is that should each IEE meet with the specifications discussed below, the Cooperating Sponor should coordinate with USAID/Ethiopia (including the Mission Environmental Officer) and submit the documents to BHR in accordance with the process outlined in DAP guidance and described in detail in the Environmental Documentation Manual (January 1999).
- **Threshold Decisions**: This PEA, as part of the outcome of its review of a representative series of Title II-funded SSI in Ethiopia, has corroborated the principle that in many, if not most, cases such activities would, in all probability, qualify for a Threshold Decision of Negative with Conditions. This PEA has identified the "conditions" wherein Cooperating Sponsors could justify such a decision. These "conditions" are presented in the form of an "Environmental Planning Checklist" (in **Section 7.2**) which specifies the type of information that must be presented as part of the IEE.
- **Environmental Planning Checklist**: It should be noted that in order to use this "checklist," there is a presumption that the Cooperating Sponsor will have a good deal more information available on the parameters of each site for which SSI is being proposed than has been the case in the past. A persistent dilemma in environmental review – requiring a compliance document like an IEE – is that frequently the considerations of the environmental issues are brought to the table when it is already too late. Environmental review is an integral part of the project cycle and begins with the conception of the project, when changing or revising a project to ensure environmental soundness is cheaper and easier than it is anytime later. This data and information required for the checklist will be essential for environmentally sound planning of SSI and will also engender a greater degree of up-front concern for and understanding of important environmental considerations associated with SSI – that will, it is believed, also lead to improved overall understanding of the issues of all types (social, technical, economic and institutional) needed for sustainable SSI.
- **Amended IEEs**: The Cooperating Sponsors would present an "Amended IEE" with the next cycle of DAP/PAA submissions that will review the sites for which a "Negative with Conditions" was specified

in the FY 1998 IEE. This Amended IEE will conform with the specifications for the information required in the Environmental Planning Checklist. These Amended IEEs could also include any additional sites for which the Cooperating Sponsors are ready to propose actions in the next or coming years of the program.

- **Potential for Positive Determinations**: Here again, although it is beyond the scope of authority of the present PEA, the Team should also indicate where or under what conditions, a "Positive Determination" requiring an Environmental Assessment might be necessary. Doing so will provide guidance for both the USAID/Ethiopia Environmental Officer and the Cooperating Sponsors to know when a proposed SSI activity goes beyond the bounds of what was sampled in the field visits for this PEA. These indications are presented in **Section 7.3**.
- **The Importance of Monitoring**: As is evident, the previous recommendations suggest that with careful attention to environmental concerns during design and planning a Cooperating Sponsor can proceed with the development of an environmentally sound SSI site, approved as a case of "Negative with Conditions." It will, nevertheless, be important to be vigilant about the possibilities for unforeseen negative environmental impacts emerging during the construction and implementation stages of the activity. The specifics of a plan to monitor for these impacts will be part of the IEE. Accordingly, **Section 7.4** will present a discussion of the important points that must be monitored as an activity goes forward. The expectation is that this "monitoring guidance" will be realistic, performance-oriented and assist the Cooperating Sponsors to ensure that the desired "Intermediate Results" are being achieved in ways that are environmentally benign.

7.2 Key Questions to be Considered in Planning SSI and Preparation of an IEE

There are many examples of planning tools, guidelines and checklists of one sort or another available to the proponents of small-scale irrigation. There can also be little doubt that the personnel charged with planning and executing these SSI activities – in the main, water resources engineers – have a good fundamental grasp of the technology and how to apply it. The PEA Team, however, believes that there are a number of very basic questions about this guidance and application that merit attention: is it relevant to the specific cases of small-scale irrigation currently being developed; is it sufficiently field and Ethiopia-oriented; is it available at the field level; and finally, is it being used successfully?

With all due respect to the considerable efforts of so many concerned and committed individuals, the findings of this PEA suggest only a very qualified positive response is reasonable for these questions. From the perspective of the PEA Team, the qualifications of the response have to do with additional questions: what is being applied, when is it being applied, how is it being applied, and by whom?

The remainder of this section will discuss the needed response to these additional questions, starting, however, with the presentation of (the "what") a new **Checklist for Planning Environmentally Sound Small-Scale Irrigation in Ethiopia** which is included as **Appendix H** of this report. Its applicability and the outcome of its use will be directly affected by the answers to the further questions of when, how and by whom it is being applied. It is tendered here with the expectation that as Cooperating Sponsors use the checklist, they send comments and/or recommendations for improvements to the BHR BEO so that it can continue to evolve and become a useful and field-realistic as possible.

7.2.1 Using the Checklist/Preparing the IEE

In a complex undertaking, nothing succeeds like advanced planning. Indeed, one of the fundamental premises on which the findings of this PEA are based, is the inherent opportunity for achieving greater probabilities of sustainability by moving environmental review to an early and prominent position in project planning. This PEA has remarked on the fact that in most cases, more information on the proposed sites for SSI is available in the IEE than in the DAP.

The proposition here is that a Cooperating Sponsor is not ready to propose a site until after it has thoroughly used the checklist to compile the data and information needed to make certain it can avoid and/or mitigate possible negative environmental impacts, i.e., the premises which will be required to "condition" its choice of a IEE Threshold Determination of "Negative with Conditions." Furthermore, dealing with the questions presented by the checklist will also reinforce the need for an in-depth analysis and response to the primary feasibility questions raised in Chapter 6.

Many Cooperating Sponsor personnel argue that they are reluctant to go too far in SSI planning because doing so "raises expectations" at the community level and that they would then find it extremely difficult to subsequently decide not to do the activity thereafter. Indeed, this is a very real and valid concern but it suggests as well that they get drawn into these activities before they have enough basic data on the overall feasibility, which may be part of the problem itself.

Perhaps, some **method of pre-planning screening is needed** or the advantages discussed above about the area or catchment approach (see **Section 6.1.2**) would apply and could help to avoid false starts or unrealistic expectations among the communities. It is clear that there must be greater certainty about some of the critical parameters of successful SSI before an activity can or should proceed to more detailed planning and community involvement, including the amount of available water resources for SSI, readily accessible and developable farmlands, and, a reasonably intact catchment or one under active protection and rehabilitation.

7.2.2 Teamwork and Participation and the Checklist

Many of the most critical and technical judgements and decisions related to the design of a small-scale irrigation scheme remain the specific purview of water resources and irrigation engineering. During the planning stage, however, they will need critical inputs from others – the farmers who will form the water users association, the larger community, and a variety of other specialists (**the Cooperating Sponsor's SSI Team**). In addition to the engineering and civil works specialists, the SSI Team carrying out the planning of a new activity should include: an agronomy or farming systems specialist, a community/environmental health specialist, a catchment/soil and water conservation specialist and a rural sociology/community institutions specialist. The Team should also have access to the services of a competent irrigation economics analyst who will help them analyze the information available on costs and benefits of the scheme.

This multi-disciplinary SSI Team will carry out the inter-disciplinary preparation of the basic planning documentation, including completing the checklist. The emphasis on the distinction between multi- and inter- is intentional; the Team must work together in responding to the questions in the checklist, best done through team meetings, rather than just assigning the responsibility for answering specific questions (the compartmentalization issue noted by the PEA Team) to one or another of the team members. These skills and disciplines, already employed by many of the Cooperating Sponsors in the preparation of the basic design documents, will be needed to competently and comprehensively address the questions raised in the checklist.

However important the completed checklist may seem, it will be the process by which it is prepared that will be the best measure of its utility. This process must be a dialogue with the user group and the larger community (the "local stakeholders"). The preparation of the checklist becomes a tool in facilitating the **genuine participatory planning and public consultation that should be part of the environmental review process** from the outset. Section 6.4 has made the very important point that building community and organizational skills as part of a systems and process approach to small-scale irrigation should be elevated to the level of one of the development objectives of the activity. Doing so will make it far more likely that the community and water users association will understand their respective rights and responsibilities and engender an important degree of self-determination and self-reliance, making it a "real" development activity.

The importance of starting early-on and having a strategy for community participation in the planning and implementation of small-scale irrigation activities cannot be over-emphasized. It will be one of the basic building blocks of moving toward improved self-reliance and avoiding the issues of dependency. Some decisions and/or understandings are fundamental to the design ("design" referring to the system and all its components and actions, not just the engineering design of the physical infrastructure) and implementation of successful SSI. These decisions should and can only be made in close collaboration with the community, including:

- understanding the size of the command area, how many farmers can be accommodated, its relationship with former schemes (in cases of rehabilitation or upgrading), the average size of the individual irrigated plot, and the overall crop and cropping pattern;
- expectations about inputs and outputs, costs and benefits, where they will come from and who will

provide them, why they are justified, and what will happen if these agreements cannot be respected.

7.3 The Potential for Positive Determinations

By definition and by choice, the PEA mechanism that was employed here presumed an assessment of "the environmental impacts that are generic or common to a class of Agency actions." [216.6(d)] It is thus important to note that the possible outcome of an IEE reaching a Threshold Determination of Negative with Conditions, under the terms (or conditionality) suggested above, would, in principle, only apply where similar circumstances for SSI occur. This PEA report cannot, however, specify where, when or why such a determination is appropriate or not. It is, nevertheless, conceivable, although not observed by the PEA Team, that there are instances where an SSI site might require a higher level of environmental review, i.e., a Positive Threshold Determination requiring an Environmental Review.

In light of this possibility, **the following list of characteristics or circumstances which might trigger a decision, either by the Cooperating Sponsor or USAID, to seek a higher level of environmental review** is presented. This list is neither an absolute set of criteria nor is it regulatory in nature; it is intended merely to sensitize those responsible for environmental review to the circumstances under which a site might fall outside of the realm of the "typical sites" reviewed under this PEA. Hence, should any of the following circumstances be part of a proposed SSI development and should the Cooperating Sponsor and USAID be convinced that they wanted to go ahead with it, it would be incumbent upon them to more carefully analyze the situation in the light of the possible need for a Positive Threshold Determination. The circumstances include:

- **Classes of Action which Have Been Determined by USAID's Environmental Procedures to Have a Significant Effect on the Environment:** Such actions may require an EA [22 CFR 216.2(d)(1)], such as agricultural land leveling, new lands development, larger scale potable water and sewerage projects, etc.
- **Size and Scale of the Undertaking**: A proposed scheme which exceeds the limits on small-scale irrigation as presently defined in Ethiopia, with a command area greater than 200 hectares.
- **Area Affected includes Tropical Forest or Protected Areas**: Based on amendments to the Foreign Assistance Act 1992, Sections 118(c)(14) and 119(g)(10) provide for denial of USAID assistance for activities that significantly degrade national parks or similar protected areas or introduce exotic plants or animals into such areas. Section 118(c)(15) requires that an environmental assessment must be performed for construction of dams or other water control structures that flood relatively undegraded forest lands (as well as other activities related to colonization of forest lands, conversion of forest to livestock rearing, and construction, upgrading or maintenance of roads passing through relatively undegraded forest).
- **Activities which Affect Biological Diversity or Endangered Species**: Section 119 of the Foreign Assistance Act and 22 CFR 216.5 (USAID's environmental regulations) specifically note that USAID must ensure that ongoing or proposed actions by the Agency do not inadvertently endanger wildlife or plant species or their critical habitats, harm protected areas, or have other adverse impacts on biological diversity.
- **Schemes based on Groundwater Pumping**: As the PEA Team did not see any such sites and is not aware of any such schemes, a decision to take this approach to water supply might merit a further analysis, even if it were small in scale.
- **Schemes with Inordinately Large Construction Activities**: The chances of serious environmental consequences tend to increase where, even though the command area may be within the range of small-scale (less than 200 hectares), one or another of the components of the basic infrastructure were larger than usual. For example, unusually long primary canals, wide dams or high dams bear additional environmental scrutiny.
- **Activities which lead to a Significant Displacement of People**: A scheme whose infrastructure development would require that large numbers of people be displaced from their homes or farm lands.
- **Activities which would Affect the Interests of a Particular Social Group**: For example, in the Ethiopian context, the development of a scheme which might negatively affect the interests of a particular social group such as by depriving pastoralists of large portions of their traditional

grazing grounds.

- **Activities requiring Large-Scale Infrastructure Development**: A scheme which in order to make its establishment possible might require the construction of large-scale infrastructure, such as an access road.
- **Activities which Introduce Exotic or Industrial Crop Species**: A scheme in which the intention is to introduce an exotic or industrial crop species otherwise unknown or untested in the area.
- **Activities in Very Degraded Catchment Areas**: The introduction of SSI as part of a catchment or watershed that is both large and highly degraded where flooding and irregular flows would be the norm.

7.4 Monitoring Small-Scale Irrigation: Key Focal Points

The Cooperating Sponsors, by their own admission, are already almost overwhelmed by the program performance monitoring requirements associated with the new "managing for results" approach being promoted by USAID. This is a concern, incidentally, also shared by USAID. Accordingly, every effort has been made to make the recommendations which follow regarding the monitoring of small-scale irrigation activities for potential environmental impacts, user-friendly, and to the degree possible, integratable into the normal monitoring routines of the Cooperating Sponsors.

The role of environmental monitoring is to ensure that negative impacts which may emerge in the course of implementation of an activity are detected and mitigated. Monitoring may also be necessary as a check against the effectiveness of a mitigation measure. Most of the negative environmental impacts associated with SSI, as identified in this PEA, are of a type that could emerge during the course of an activity and its implementation. The following recommendations suggest an array of key focal points, conditions and procedures for monitoring SSI schemes. As the reader will note, in many cases these suggestions are directly related to the monitoring of scheme performance and the realization of its desired intermediate results.

Farmer participant satisfaction will doubtlessly be a primary performance monitoring indicator. It can and should be a combined indicator to trigger concern about environmental issues. The PEA Team recommends that the Cooperating Sponsor monitor this indicator through **continuing and concerted attention to the functioning of the Water Users Committee during the "Start-Up" phase,** also as proposed in this report. Dealing with issues related to participant satisfaction is the essence of the workings of such an entity. Working with this group will better enable the personnel responsible to probe cause and effect with the users, to identify solutions to the problems (mitigation measures), and to more directly operationalize a response to a detected environmental problem. By dealing with all these issues, the personnel involved will reinforce their problem-solving capabilities of the committee and the community and their sense of self-reliance.

Among the general performance issues that might lead to further scrutiny and discussion within the WUC about environmental concerns, are the following:

- Smaller than foreseen command area or fewer numbers of households able to access irrigated plots.
- Lower average yields than anticipated.
- Higher than expected operations and maintenance costs.
- Emergence of health problems previously unknown in the community.
- Social conflicts within the community or with adjacent communities.

Cause and Effect

Identifying the real causes of a problem are as important as detecting it. Understanding causality will be essential to mitigation as well. Monitoring without a baseline or an expectation about outcomes would be both frustrating and futile. Failure to identify the real causes of a problem means that one often can do no more than treat the symptoms, without lasting effect. The use of the Environmental Planning Checklist should lead to a sound data and information baseline on which to begin to analyze impacts and their causes.

More specifically, however, those responsible for monitoring (ideally a combination of personnel with the requisite skills and including a representative of the WUC) will have a series of tools, in addition to the IEE and its companion, a completed Environmental Planning Checklist, available for their use in investigating problems and identifying their causes; these should include, at a minimum:

- The continued operation of **simple stream gauging and weather stations** and their records that document water flows and help to build an understanding of the relationship between local climate and water available to the system.
- The availability of the **Environmental Health Impact Report** and a working relationship with the local health officers so as to ensure the early detection of the incidence of disease.
- A **summary seasonal operational plan** which documents the expectations regarding water availability, size of the command area, number of users, operations and maintenance requirements, cropping pattern and anticipated crop yields, and required inputs, endorsed by the Water Users Committee.
- A **chronological scheme record** which registers the realizations and experience with the implementation of the irrigation system.

Difficulties during Operations and Maintenance

Much of this report has focused on the importance of the correct planning, design and construction of SSI schemes. Even where every precaution has been taken, environmental issues can arise during operation and maintenance of the scheme. The PEA Team believes that **the best approach to dealing with these issues begins with equipping the participants to recognize that they are occurring**, and to do so in a practical and participatory way. This can begin by alerting the WUC officers, the Development Agents assigned to the scheme, and the user community to the readily visible signs of these difficulties. External inspection is, over the long-run, much less likely to engender responses among the user community. The following list of **visual indicators of problems** with operations and maintenance (after Tillman 1981) could be tailored to the situation in each scheme and the user community made responsible for bringing them to the attention of the WUC and/or the DAs:

- Standing water in canals, drains, on cropland, borrow pits or on adjacent lands.
- Weed or sediment-choked canals or drains.
- Excessive seepage at turn-outs or from canal banks.
- White crusts or deposits on cropland surfaces.
- Non-functional or missing gates or water control devices.
- Abandoned canals, drains or croplands.
- Depressions or excavations at turn-outs, outfalls or water control structures.
- Uneven patterns of crop growth in the same field.
- Incidents of irrigation water being used for domestic purposes.
- Bank erosion within the canal system.

Appendices

Appendix A

Scoping Statement: Programmatic Environmental Assessment (PEA)

1. Introduction and Rationale for the PEA

USAID's environmental regulations (22 CFR 216), commonly known as Reg. 216, establish the conditions and procedures for environmental review of the activities funded with Agency resources. In late 1996, a decision was made to include P.L. 480 (Food for Peace), Title II food aid assisted programs, within the ambit of the programs and projects requiring compliance with Reg. 216. This decision was a reflection of the reality that many of these programs are increasingly being used to fund development activities in line with the transition along the "Relief to Development" continuum. "Of the $821 million of Title II funding in FY 97, $309 million was provided to Cooperating Sponsors to carry out development food aid programs, which support activities in maternal and child health, agricultural production, natural resource management and infrastructure development (e.g. roads, bridges, latrines, wells and small-scale irrigation systems)." (USAID, 1998)

Accordingly, with support from USAID's Africa Bureau, and in particular staff within the Office of Sustainable Development (AFR/SD/ANRE) and the Regional Environment Officer (REDSO/ESA REO), the Cooperating Sponsors (CS) began a process to respond to this mandate. This effort included the preparation of explanatory documentation regarding the process and procedures and a series of training workshops for USAID and CS staff in Africa. One such workshop was held in Mekelle, Ethiopia in February 1997, at which time all the Title II Cooperating Sponsors were represented. One of the key themes highlighted during the workshop was the explicit recognition that properly designed and executed development activities which would achieve greater positive benefits for the participants, and would, in turn, be far less likely to lead to negative impacts on the environment. Another issue which arose at all the Africa-based workshops was the question of how to handle irrigation activities being carried out by the Cooperating Sponsors within the framework of compliance with Reg. 216.

Among other things, the outcome of this workshop and subsequent discussions between the Agency and the Cooperating Sponsors, identified the fact that certain activities typically part of the Title II funded program in Ethiopia would fall within the "class of actions normally having a significant effect on the environment" [216.2(d)]. One of the most notable of these classes of actions, and one of concern to the majority of the Cooperating Sponsors in Ethiopia, is "irrigation or water management projects including dams and impoundments" [216.2(d)(ii)] which require an environmental assessment.

These Title II funded irrigation activities are important both programmatically and in terms of their potential impact on food security in the country. Despite the fact that these actions were typically small in scale, a Positive Threshold Decision for this class of actions would be the outcome of the Initial Environmental Examinations being prepared by the Cooperating Sponsors as part (Section M) of their Development Activities Proposals (DAPs) submitted to USAID Bureau for Humanitarian Response (BHR). In order to allow this important program component to proceed, it was decided that the Initial Environmental Examination would propose a Negative Determination with Conditions for all FY 99 irrigation activities and a Deferral [216.3(a)(1)(iii)] for all such activities in the out-years of the respective DAPs. The primary condition for these Negative Determinations, beyond the stated mitigation and monitoring measures, as decided by USAID and the Cooperating Sponsors, was to carry out a Programmatic Environmental Assessment (PEA) of small-scale irrigation. It was recognized that the PEA procedure [216.6(d)] would have good applicability to the situation of the USAID Title II Cooperating Sponsors because the mechanism was specifically foreseen "as appropriate to....assess the environmental impacts that are generic or common to a class of agency actions."

Catholic Relief Services (CRS), after consultation with USAID and the other Cooperating Sponsors working in Ethiopia, agreed to take the lead in carrying out this Programmatic Environmental Assessment of Small-Scale Irrigation, utilizing funding available to it through its Institutional Strengthening Grant (ISG). CRS is convinced that all efforts to improve the design and execution of Title II funded activities should be its primary concern and that this objective is completely in accord with the objectives of its ISG; hence, the decision was made for CRS to take a leadership role in carrying out this PEA. Therefore, following the procedures specified in Reg. 216, this document constitutes a Scoping Statement [216.3(a)(4)] as required for all environmental assessments.

The present Scoping Statement has been prepared with the on-site assistance of the Regional Environment Officer (REDSO/ESA REO) and a Scoping Team (see Appendix A) assembled by CRS. The Scoping Process, carried out between July 27 and August 14, consisted of consultations with relevant Government of Ethiopia agencies, Cooperating Sponsors, USAID, and other donor and non-governmental organizations. This Scoping Statement will be submitted for review and approval to the BHR Bureau Environment Officer as per the specifications in [216.3(a)(4)(ii)].

1.1 Purpose of the PEA

This PEA has multiple objectives:

- Facilitate and encourage the identification of environmental issues early in the planning cycle; design environmental improvements into these activities and thereby avoiding the need to mitigate or compensate for adverse impacts.
- Advance an understanding of state-of-the-art, sustainable small-scale irrigation, by developing a document that will be useful to USAID and Cooperating Sponsors (and others working with these types of investments) in determining whether or not to proceed with small-scale irrigation development and how to efficiently and effectively plan and manage these activities.
- Build staff capabilities and organizational systems which lead to more sustainable small-scale irrigation systems.
- Facilitate the ability of the Title II Cooperating Sponsors and USAID/Ethiopia to comply with the statutory requirements of Reg. 216 as they apply to their small-scale irrigation activities.

2. Brief Background Description of the Program Being Assessed

2.1 PEA in the Context of the USAID Mission Strategic Plan

Although the food situation in Ethiopia has improved in recent years, it is expected that the country and her people may "remain vulnerable to drought and food shortages for years to come. Even with good harvests in these 'normal times,' both acute and chronic hunger and malnutrition occur among many Ethiopians." (USAID, 1998) For these reasons, the USAID Strategic Plan includes a Special Objective (SPO): Enhanced Household Food Security in Target Areas, thereby contributing to the U.S. Government's Mission Performance Plan for Ethiopia of "Providing Humanitarian Assistance."

At present, the ongoing activities of the eight Title II Cooperating Sponsors (SCF/USA, CARE, CRS, WV, REST, FHI, Africare, EOC) constitute the principal mechanism for implementing the program assistance foreseen under this Special Objective. Indeed, the SPO itself was developed in collaboration with the Cooperating Sponsors who all have a long history of humanitarian relief and commitment to the country. The SPO identified five critical intermediate results:

IR1: Increased Agricultural Production

IR2: Increased Household Income

IR3: Improved Health Status

IR4: Maintaining the Natural Resource Base

IR5: Maintaining Emergency Response Capacity.

Although this PEA on small-scale irrigation has its origins in the Reg. 216 requirements, the Scoping Team believes that its focus fits as well with the performance-based criterion adopted by USAID as its primary measure for continued support to program activities. This PEA is being designed with the objective of viewing small-scale irrigation from a broader perspective and with a focus on results and not just on the completion of planned activities. By its very nature, a programmatic assessment is results-oriented. While irrigation is mainly seen as one of the activities contributing to the realization of IR1- Increased Agricultural Production, this PEA will demonstrate that sound design and effective implementation will not only avoid negative environmental impacts but will contribute to the achievement of the other Intermediate Results and, ultimately, to the Special Objective of Enhanced Household Food Security in Target Areas.

For example, small-scale irrigation makes it possible to diversify crop production and capture the opportunities for the production of fruits and vegetables within the expanding market economy. The sale of these crops responds directly to IR2- Increased Household Income. Likewise, good small-scale irrigation will take into account and plan for the control of disease vectors and water-borne diseases commonly associated with these schemes, thus contributing to IR3- Improved Health Status of Target Households. Finally, one of the basic premises of the development of small-scale irrigation is to curtail the need of rural people to crop marginal lands and degrade the natural resource base through erosion and soil depletion. This will contribute to the achievement of IR4- Natural Resource Based Maintained.

2.2 Relationship of the PEA with Government of Ethiopia and Other NGO Programs

The development of the country's irrigation potential is an important part of a "major program for the intensification of agriculture" launched by the new Federal Government (EPA, 1997). As part of this effort, a draft Water Resources Policy, designed to guide water sector development into the next century, is presently being circulated among the concerned ministries and agencies for review and comment . Although the PEA Scoping Team was unable to obtain a copy of this internal draft at present, they were told that it will underscore the opportunities and challenges to developing small-scale irrigation. In discussions with the Ministry of Water Resources Design Department, the team was told that it was high time for such an assessment (the PEA) of small-scale irrigation.

It is also worth noting that during its consultations, the PEA Scoping Team was apprised of a number of initiatives aimed at further developing the processes and capabilities for environmental review in Ethiopia. The Government's Environmental Protection Authority (EPA) has now published an "Environmental Impact Assessment Guideline" along with a series of sector-specific guidelines, including one devoted to agricultural sector development projects (EPA, 1997a). The EPA anticipates that these guidelines will soon be officialized through their publication as governmental regulations. Similarly, the Ethiopian Social Rehabilitation and Development Fund (ESRDF), part of a program funded by the World Bank to fund small-scale development activities with local NGOs and civil society organizations, has also published an "Environmental Checklist" as a companion piece to its multi-volume project appraisal guidelines (ESRDF, n.d.). And, lastly, Lutheran World Federation has recently prepared environmental review guidance and has initiated a year long study to incorporate environmental review into project planning.

Environmental planning and oversight capabilities are also being developed at the Regional level. Several of the nine regions that now make up the Federal Democratic Republic of Ethiopia are in the process of establishing Regional Commissions for Sustainable Agriculture and Environmental Rehabilitation. Several regions now have well-established commissions of this type. The development of these commissions has been a major outcome of the Sustainable Agriculture and Environmental Rehabilitation Program — a programmatic undertaking of the United Nations Economic Commission for Africa (UN/ECA), with funding from the United Nations Development Program (UNDP). The goals of this program are intended to support the Government of Ethiopia's policy mandates for decentralization and participatory development.

One of the most advanced of these regional commissions is the commission in Tigray (Sustainable Agriculture and Environmental Rehabilitation of Tigray- SAERT) which will soon be assisted by a CIDA-funded project—the Water Harvesting and Institutional Strengthening in Tigray (WHIST) project. As its name implies, this project will provide technical assistance and institutional support to SAERT. This assistance is specifically targeted at increasing the organization's capabilities in the area of sustainable water harvesting for human and livestock use and for irrigation —key elements of the Regional Development Plan for Tigray. It is expected that the commissions will, in addition to promoting and guiding development projects and programs directly, also serve as an agency to review the plans of other donors and organizations to ensure their compatibility with the regional plan and their sustainability.

2.3 Synopsis of the Title II Funded Small-Scale Irrigation Activities

The PEA for which this Scoping Statement is being prepared will include the activities of the six Cooperating Sponsors presently using Title II resources for small-scale irrigation in Ethiopia; they are: CARE, Catholic Relief Services (CRS), Ethiopian Orthodox Church (EOC), Food for the Hungry International (FHI), Relief Society of Tigray (REST), and World Vision International (WVI). At present, Save the Children Foundation (SCF/US) and Africare are not presently including small-scale irrigation in their DAPs. The CRS program is being implemented in cooperation with two of its counterparts: Adigrat Catholic Secretariat (ADCS) and the Hararge Catholic Secretariat (HCS).

2.3.1 Typology of Small-Scale Irrigation Systems in Ethiopia

In Ethiopia, small-scale irrigation (Ethiopian definition) is considered to be any system that supplies a total command area of under 200 hectares (as opposed to medium-scale: 200 to 3000 hectares and large-scale: 3000 hectares and above). None of the present small-scale irrigation activities being undertaken by the Cooperating Sponsors with Title II resources, with one exception, and as currently described in the IEEs, will exceed 200 hectares. It has been estimated, in the country report to COMESA, that there are approximately 109,000 hectares of modern small-scale irrigation and 80,000 hectares of traditional small-scale irrigation in the country. The typology presented here is based on water source and on distribution technology.

Diversion systems

Often referred to as offtake systems, diversion systems are probably the most common form of irrigation system in Ethiopia. Diversion systems often utilize natural river flow, however regulation of river flow via a permanent structure in the river bed is also a common practice to increase the offtake. Diversion systems abstract water over a sustained period of time and are able to deliver regular irrigation throughout a cropping system. A key characteristic of diversion systems is the adequacy of water supply during the dry seasons and the ability to irrigate a dry season crop in addition to providing supplemental irrigation during the rainy seasons.

Spate systems

Spate systems make use of occasional flood flows of ephemeral streams, and therefore operate intermittently during only part of the year. In Ethiopia, there are two types of spate systems. The first, often referred to as a run-off system, diverts run-off from rainfall received in the same catchment from natural waterways on to agriculture land. The second, most common on foothill sites in arid and semiarid areas, divert flood flows originating in highland areas. Spate systems have proved difficult to rehabilitate due to the difficulty of designing weirs to divert flows that change dramatically over short period of time and which also resist structural damage from flood flows.

Spring systems

These systems exploit flows from small springs. Water is often shared with household and livestock users. Water is often stored over night in small reservoirs (night storage) and emptied daily.

Storage systems

These systems, referred to as tanks in South Asia and earthen dams in Ethiopia, store water for an extended period behind dams. In Ethiopia, storage systems are a recent introduction and pose technical and production challenges. It is important to consider the catchment flow and amount of sediment in designing storage systems. Cropping must be planned according to the amount of water stored and available for irrigation. Typically the irrigable area is much larger during the rainy season than during the dry season.

Lift systems

Lift systems extract water from rivers, irrigation canals, reservoirs and wells. Lift systems have lower development costs, but usually have higher operating costs. Pumps include manual and motorized.

The following table provides a synopsis of the small-scale irrigation activities of the six Cooperating Sponsors, as found in their respective IEEs.

3. Determination of the Issues to be Analyzed: Scope and Significance

3.1 Issue Identification Methodology

The Scoping Team used a series of semi-structured interviews to identify the range of issues affecting small-scale irrigation in Ethiopia. This process of consultation was carried out with irrigation and environmental specialists of the Cooperating Sponsors, government officials, other Non-Governmental Organizations and with donor Agencies (see Annex B for a list of individuals and organizations consulted). Discussions were opened with the question:

In your opinion, what are the key factors in successful irrigation?

This generated the following list:

- Build on traditional practices
- Community initiative
- Well planned/designed
- Small-scale
- Adequate water for all users - water sharing
- Good market access
- Profitable investment
- Strong water use association
- Good extension and training support
- Secure access to land
- Supportive policies
- Access to credit
- Integrated watershed management approach
- Health support

The discussion on key factors in successful irrigation was followed by a discussion on the prevalent problems encountered in irrigation development. This generated the following list (see Appendix D):

- Lack of hydrologic data for planning
- Siltation of reservoirs
- Faulty design and construction
- Inequitable allocation of irrigated plots
- Increase incidence of vector borne diseases
- Less water for downstream users
- Difficulty of communities in operating and maintaining systems
- Poor water distribution
- Erosion and sedimentation of canals
- Lack of access to markets
- Increase in diarrhea and other illnesses due to drinking reservoir and canal water

3.2 Issues to be Addressed in the PEA

Following the scoping consultations, the key factors in successful irrigation and the prevalent problems encountered in irrigation were analyzed. This resulted in the following issues to be included in the PEA:

Technical Issues

Integrated watershed management

- Hydrology and hydrologic monitoring
- Irrigation engineering
- Soils
- Crop production
- Integrated pest management

Environmental Health Issues

Vector borne diseases (malaria)

- Water contact diseases (schistosomiasis)
- Water borne diseases (diarrhea, typhoid, guinea worm etc.)
- Health care support

Table A3.1: Synopsis of Small-Scale Irrigation Activities by Cooperating Sponsor

Cooperating Sponsor Program	Spring Systems			Diversion Systems			Spate Systems			Storage Systems			Lift Systems		
	No. of Sites	Total Area	No. of HHs*	No. of Sites	Total Area	No. of HHs	No. of Sites	Total Area	No. of HHs	No. of Sites	Total Area	No. of HHs	No. of Sites	Total Area	No. of HHs
CARE Ethiopia DAP Food and Livelihood Security Program (FY 1997- FY 2001)															
FY 99	9	NA	NA	1	200	200	3	NA	NA	1	NA	NA			
Out-Years															
Catholic Relief Services Ethiopia DAP (FY 1997 - FY 2001)															
FY 99					2	18	375	25	104	167					
Out-Years		6	36.3	755				25	115	529					
Ethiopian Orthodox Church Development and Inter-Church Aid Commission (EOC-DIDAC) DAP (FY 1998 - 2003)															
FY 99					6	95	405								
Out-Years					20	211	734								
Food for the Hungry International Development Project (FY 1999 - FY 2001)															
FY 99	2	11	81		6	NA	NA								
Out-Years					8	NA	NA								
Relief Society of Tigray Integrated Food Security Program (FY 1999 - FY 2003)															
FY 99					2	130	650								
Out-Years					15	60	4,080								
World Vision International Development Activity Proposal (FY1998 - FY 2002)															
FY 99					1	20	100								
Out-Years															

Note: Data for outyears was not consistently supplied in the Cooperating Sponsors' IEEs. Thus the absence of entries in the outyears' rows merely reflects lack of data.

* HH=-households

Social Issues

Irrigation management structure

- Land tenure
- Hydraulic tenure and water rights
- Conflict resolution
- Community participation in irrigation design, operation and maintenance
- Women's participation and impact on women

Economic Issues

Cost benefit analyses (considering cash, food wage and community labor costs)

Labor

- Access to markets
- Access to credit

Ecological Issues

Wetlands

- Biological and genetic diversity

Environment and Irrigation Policy and Institutional Support Issues

Ethiopian Federal government policies (EPA)

- Ethiopian Regional government policies
- Research and extension support
- USAID policies
- Training and capacity building

3.3 Issues not to be addressed in the PEA

Again, based on the scoping consultations, a list of environmental issues that will not be considered in the PEA was developed. These issues include:

- Geology and seismic risk
- Air pollution
- Agrochemical contamination
- Noise
- Fisheries
- Wildlife
- Urban quality
- Historic and cultural resources
- Population displacement (except as relates to prevention of malaria)
- Attraction of population
- Depletable resources
- Energy requirements

3.4 Scope and Significance of Each Issue Identified

3.4.1 Technical Issues

Integrated watershed management

Prevention of reservoir sedimentation and damage to irrigation infrastructure due to flooding, erosion and sedimentation requires an integrated watershed management approach. Irrigation development should be integrated with activities that treat the entire micro-catchments in which the irrigation system is located.

Hydrology and hydrologic monitoring

The lack of hydrologic data was mentioned repeatedly as a problem contributing to poor irrigation design. When hydrologic data is lacking, engineers attempt to correlate site hydrology with data from the nearest available catchment, with a considerable loss in precision. Hydrologic data is also required in monitoring and mitigation. An example is the impact of the irrigation construction and use on stream flow and depth to water table.

Irrigation engineering

Irrigation engineering includes the related topics of design, construction, operation and maintenance of an irrigation system. Traditionally, farmers work with the hydrology and geomorphology of an area in designing their systems. Modern engineering solutions, developed for larger systems, often lead to problems when applied to the redesign of traditional systems.

Soils

Soil management is critical to sustainable and productive irrigated crop production. It includes the issues of soil fertility maintenance and the prevention of salinization. Soil information is needed in designing reservoirs and canals and determining the irrigation duration and interval.

Crop production

Ultimately, the sustainability of irrigated cropping depends on achieving community goals of increased food security and income generation. Exploiting irrigation in intensifying crop production requires changes in agricultural practices; which in turn, requires effective and sustained research and extension support.

Integrated pest management

Increasing the amount and the duration of soil moisture enables changes in cropping practices, including the monocultures and double cropping. This, in turn, creates conditions for the emergence of new weed, disease and insect pests. Crop specific management practices need to be developed to provide economic pest control without environmental impact from pesticide use.

3.4.2 Environmental Health Issues

Vector borne diseases (malaria)

Malaria is a vector borne disease endemic to the tropics and subtropics. The malaria vector lives near and breeds in lakes, ponds, rivers, streams, coastal plains and human settlements. Hydrologic changes, resulting from irrigation development or dam construction, can lead to a significant increase in mosquito breeding sites. Environmental health engineering can modify the irrigation environment so as to reduce or eliminate the vector habitat.

Water contact diseases (schistosomiasis)

Schistosomiasis is endemic in many parts of Ethiopia. There are an estimated three to five million infected persons at present in Ethiopia. Irrigation development contributes to the spread of schistosomiasis through the creation of favorable habitats for snails, the alternative host. The infective stage of schistosomiasis can penetrate the skin of a person who enters the water and cause infection. Schistosomiasis can be controlled by treatment, reduction in water contact, reduction in contamination through health education and sanitation, and by the removal of snails.

Water borne diseases (diarrhea, typhoid, guinea worm etc.)

Water borne diseases can be prevented by discouraging people from using reservoir, canal and drainage water for drinking and washing. This can be done by providing a safe and convenient source of water and by linking irrigation development with health education and sanitation programs.

Health care support

The prevention of adverse environmental health impacts resulting from small-scale irrigation development requires close cooperation with health programs, investment in water and sanitation infrastructure and health education and in the monitoring of irrigation related health risks.

3.4.3 Social Issues

The social issues are linked to equity and environmental justice - equitable distribution of the benefits of irrigation development and assurance that the environmental impacts do not disproportionately burden the least powerful members of the community.

Irrigation management structure

Irrigation involves community action in the operation and maintenance of systems in conformance with agreed upon rules for sharing water and scheduling production and irrigation. Traditional rules, often difficult to change, make it difficult to take advantage of changes in irrigation design or in production opportunities. Successful irrigation development requires a profound understanding of the traditional irrigation management practices.

Land tenure

Land tenure in Ethiopia is diverse, complex and evolving. Irrigation development in communities with conflicting or uncertain claims to land is problematic. Successful irrigation development requires an understanding of how land is owned and transferred and how land disputes are resolved.

Hydraulic tenure and water rights

Water rights need to be understood in relationship to the initial investment in irrigation and to the continuing maintenance of the systems. Hydraulic tenure can be earned through investment in initial construction, endowed by landlords, conferred by the state, or claimed when governments change or reforms are effected. Successful irrigation development requires an understanding of water rights and hydraulic tenure.

Conflict resolution

Conflict is a risk whenever there is competition for scare water and land resources, either within an irrigation system or between irrigation systems. Conflict often arises between upstream users, who begin to use or increase their use of water and downstream users, who may have prior appropriation rights to the water. Any change in the availability or use of irrigation water requires consultation to ensure equitable sharing and avoid conflict.

Community participation in irrigation design, operation and maintenance

Community participation is often neglected in irrigation development. Involvement of the community can ensure that the design is compatible with the needs of the community, build local skills and keep management responsibilities in the hands of the community.

Women's participation

The role of women in irrigation management and irrigated cropping is often overlooked. Women who had usage rights to rainfed land may lose those rights when irrigation is developed. Women, especially single parents, may have difficulty in complying with the labor requirements for construction and maintenance; and therefore lose an opportunity to acquire irrigated land. The increased household labor requirement of irrigation may fall disproportionately in women. Anticipating the negative impact of irrigation development on women and a proactive search for opportunities for positive impact can ensure that women receive an equitable share of the benefits from irrigation.

3.4.4 Economic Issues

Often the lack of a direct economic impact can lead to indirect environmental impacts leading to resource degradation.

Cost benefit analyses

There are three cost levels in irrigation; cash costs, the food wage paid for FFW and the recipient community labor contribution. A cost benefit analysis is needed in analyzing alternative irrigation strategies, in assessing the sustainability of the system and in assessing the attractiveness of irrigation in relationship to alternative investments.

Labor

Irrigation development increases the labor requirement directly through construction, maintenance and operation, and indirectly through intensified crop production and double cropping. From a farmer perspective, the return to labor in irrigated crop production is as important as the return to land.

Access to markets

Access to markets is a determinant of the profitability and sustainability of irrigation. Market access lowers the costs of recurrent inputs, such as seed and fertilizer, and increases the farm gate prices for produced goods.

Access to credit

Along with access to markets and relevant research and extension information, access to credit ensures that farmers are able to take advantage of the production opportunities created by irrigation development.

3.4.5 Ecological Issues

Wetlands

Changes in hydrology, brought about by irrigation development, have an impact on wetlands. Wetland habitats, which are biologically diverse, serve to mitigate flooding during the rainy seasons, serve as dry season pasture and are the source of many useful products.

Biological and genetic diversity

Any change in the hydrologic, edaphic or biologic environment can have an impact on biological and genetic diversity. Ethiopia is the center of origin and the source of genetic diversity of sorghum, barley, wheat, coffee, teff, enset and many spices. Changing the environment and subsequent crop choices can result in the irretrievable loss of valuable diversity.

3.4.6 Environment and Irrigation Policy and Institutional Support Issues

Ethiopian federal government policies

The Conservation Strategy of Ethiopia "takes a holistic view of the natural, human-made and cultural resources, their use and abuse, and seeks to integrate existing and future plans into a coherent framework." The Federal Environmental Protection Authority (EPA) has recently produced Environmental Impact Assessment Guidelines for agricultural sector development projects, including irrigation. The Ministry of Water Resources has produced a draft Water Resources Policy paper to guide irrigation development in the country.

Ethiopian regional government policies

Environmental policies are operationalized at the regional levels through the regional Sustainable Agriculture and Environmental Rehabilitation Teams (SAERTs), with guidance provided by the Regional Environmental Coordinating Committees (RECCs).

Research and extension support

Irrigation development provokes a change in cropping systems and in intensification (double cropping, increased use of inputs). Research and extension support to irrigated agriculture is needed to ensure that the investment is profitable and sustainable. Research and extension support is also important in ensuring that mitigation practices are in place and that monitoring provides warnings when thresholds are reached so actions can be taken.

USAID policies and support

In supporting irrigation development, USAID is concerned with quality programming, performance monitoring and environmental compliance. Supervision needs to be carried out through a combination of the completion of the IEEs by the Cooperating Sponsors, the submission of compliance reports and site visits to review implementation of environment mitigation and monitoring activities.

Training and capacity building

The PEA will include the analysis of the overall capacity of the communities, the Cooperating Sponsors and USAID to implement and supervise environmental sound irrigation development activities. It will include recommendations on training and capacity building that extend beyond the PEA proper.

3.5 Brief Discussion of the Issues Not to be Covered in the PEA

After the Scoping consultations, several issues were excluded from the scope of the PEA because they were judged to not have a significant impact on the environment.

- Geology and seismic risks will not be considered because these issues will be covered under design criteria for reservoir construction.
- Air pollution, primarily fugitive dust and noise, were not serious problems due to the lack of heavy machinery in construction and the temporary nature of the construction.
- Agrochemical contamination is not considered a problem due to the current and projected low usage of chemical fertilizer.
- Pesticide contamination will be covered under Integrated Pest Management.
- Fisheries and Wildlife will not be considered because none of the irrigation development sites are currently or will in the future be located in or near protected areas.
- Urban quality of life is not relevant to the development of irrigation in rural areas.
- Historic and cultural resources are known to the local communities and are not typically found on the lower landscape positions where irrigation development takes place.
- Population displacement due to irrigation construction or the attraction of population to the site after development are not significant impacts due to the small scale of the irrigation development.
- Energy requirements are not considered to be significant because construction, operation and maintenance of small-scale irrigation systems is done almost entirely with hand labor. The energy requirement of motorized pumps will be covered in the discussion of lift systems.
- The impact of reservoirs - for irrigation as well as for livestock - on water quality and human health will not be considered. Potable water and sanitation are distinct issues from small-scale irrigation and need to be addressed in a separate PEA. The impact of reservoirs on vector-borne diseases will be considered.

4. PEA Procedures

4.1 Outcome of the Scoping Process

The Scoping Process, carried out from 27 July to 14 August 1998, in both Nairobi and Ethiopia, has laid the groundwork for the implementation of the Programmatic Environmental Assessment of Title II funded small-scale irrigation activities carried out by the Cooperating Sponsors in Ethiopia. More specifically, it has achieved the following:

- provided for an identification of the key issues to be assessed during the PEA;
- led to the identification of the focus disciplines of the personnel to be employed as an interdisciplinary team for the implementation of the PEA;
- proposed a typology of small-scale irrigation to assist in the description and diagnosis of the small-scale irrigation systems of the present Title II program in Ethiopia; and
- underscored the importance of sound design, construction and implementation of small-scale irrigation development as a precursor to avoiding negative environmental impacts.

4.2 Methodology, Timing/Phasing of the PEA

In order to carry out the PEA, the Scoping Team envisages the following arrangements, methods, timing and phasing:

Continuing Consultative Process

This Draft Scoping Statement will be sent to the USAID/Ethiopia Mission (FHA, ANR), the six Cooperating Sponsors with small-scale irrigation activities and CRS (East Africa Regional Office and Program Quality and Support Department) on 21 August 1998 for comment prior to sending the document to the BHR BEO.

Interim Period

The Scoping Team anticipates that a final version of this Scoping Statement will be forwarded to the BHR Bureau Environmental Officer for his review and approval on or about 11 September 1998. The BHR BEO, at his discretion, will distribute the Scoping Statement to other USAID offices such as the Africa Bureau BEO and FFP. This will allow for a period of approximately seven weeks for review and approval and for the additional preparations essential to the effective implementation of the PEA starting on or about 2 November 1998. It is worth noting that this delay will also allow for the onset of the actual period in which irrigation is actually being carried out by farmers in Ethiopia, thus providing the PEA team with an opportunity to see schemes in action. During this interim period, CRS personnel (in Addis Ababa and Nairobi) and the consultant team leader (by e-mail from his home base) will: prepare scopes of work for each additional team member; develop a series of analytical tools to be used during the assessment; develop a tentative schedule for field visits, prepare a budget, identify and acquire additional pertinent reference materials; and recruit locally hired members of the team.

PEA Implementation Period

The proposed period for the implementation of the PEA will be approximately seven weeks beginning on or about 2 November and finishing before the onset of the Christmas holidays. Two principal phases are foreseen: approximately four to five weeks of data collection and analysis, including field visits and two to three weeks of report preparation. More specifically, it is envisaged that the implementation period will involve:

- Identification and review of additional relevant small-scale irrigation **literature and reference materials**.
- **Continuing Series of Interviews**: More interviews, both at the Federal/Addis and at the regional levels, will be an important activity of the PEA team. These will be carried out using semi-structured interview procedures with key specialists and perhaps convening small “brainstorming” sessions with regional staff concerned with irrigation, environment, agriculture and natural resources management, including both governmental personnel, cooperating sponsor staff and other knowledgeable people.

- **Field Visits**: Visits to approximately 20 small-scale irrigation scheme sites are foreseen, both works in progress and operational schemes, all part of the activities of the six Title II Cooperating Sponsors named above. The sites, to be chosen in close consultation with these partner organizations, will cover the full range of small-scale irrigation types discussed in the typology above. Prior to the actual site visit, descriptive project profiles according to a pre-determined proforma will be prepared with the assistance of Cooperating Sponsor staff to optimize the time spent on site for observation and analytical work. The visits will cover irrigation development activities in the following regions of the country: Tigray Amhara, Oromiya, Die Dawa and the Southern Ethiopia Peoples' Administrative Region. This will provide a representative set of case studies. Visits will not be made to the extreme east and west of the country where there are few, if any, irrigation activities carried out by the Cooperating Sponsors.

- **Inter-disciplinary Team Approach**: The multi-disciplinary PEA team will follow a rigorous inter-disciplinary approach in its work, including: joint preparation for field site visits (identification of key issues and their interplay); interviews (semi-structured interview protocol and the designation of a lead person and rapporteur); comprehensive screening guidelines for each site to ensure that all issues are covered and team responsibilities for coverage clearly understood; post-visit wrap-up and review sessions, both with cooperating sponsor staff and among the team itself, to discuss findings and highlight issues; and, focused inter-team discussions to identify mitigation and monitoring actions.

Report Preparation and Review

The following plan for the preparation and review of the PEA report is foreseen: draft PEA report prepared and compiled, with contributions from each team member by the team leader and deputy team leader; inter-team review; circulation of the draft to the Cooperating Sponsors and USAID personnel, seeking written comments within a specified deadline; a one or two day workshop in Addis to review the draft PEA with representatives of the Cooperating Sponsors, USAID/Ethiopia and the Regional Environment Officer and (perhaps) other recognized local specialists from other government, donor and non-governmental organizations; and finally, preparation of a final draft incorporating the comments and suggestions made, by the team leader, for submission to the BHR Bureau Environment Officer for his review and approval.

Post-PEA Process: After the PEA has been approved by the BHR BEO the document will be distributed to all interested parties, including Cooperating Sponsors, USAID, Government of Ethiopia agencies etc. Follow-up activities (trainings, study tours etc.) will be discussed at this time as well.

4.3 Team Make-Up

Team Leader	Tom Catterson	Consultant
1. Deputy Team Leader	Moges Worku	CRS/Ethiopia
2. Sociologist	Mesele Endelaw	CRS/Ethiopia
3. Health Specialist	Carmela G. Abate	Consultant
4. Agronomist	Frank Brockman	CRS/Baltimore
5. Irrigation Engineer	Abebe Wolde	MoA Consultant
6. Economist	Kibru Mamusha	CRS/Ethiopia

4.4 Ethiopia Small-Scale Irrigation Programmatic Environment Assessment Outline

The Scoping Team proposes the following draft outline for the PEA

Executive Summary

Purpose and Need for Small-Scale Irrigation in Ethiopia

Food insecurity in Ethiopia

- Small-Scale Irrigation - potential and importance
- Importance for Small-Scale Irrigation for Cooperating Sponsors

Purpose and Need for PEA

Need for increasing effectiveness and impact of Small-Scale Irrigation Investment

- Need for environmental compliance (22 CFR 216)

PEA Methodology

Process

Scoping

- PEA process described (Materials and Methods)

Consultation and Coordination

- Review
- Relationship to other Ethiopia Environmental Documentation

Relationship to Guatemala and India PEAs to be carried out by CRS

Small-Scale Irrigation – Classification, Description, Diagnosis and Discussion

Classification and discussion of the range of irrigation investments undertaken by CSs

Discussion of problems identified

Proposed solutions to problems

Alternatives, Including the Proposed Action

Definition of the Proposed Action: Small-Scale Irrigation

- Alternatives to Small-Scale Irrigation

No Action Alternative

- Alternative Food Security Activities
- Comparison of Alternatives

Preferred Alternative

Current status of Small-Scale Irrigation and the Affected Environment

Ethiopian Environment

- Small-Scale Irrigation Environmental Issues

Technical

- Health
- Social
- Ecological
- Economic

Institutional, policy and support

Environmental Consequences of Small-Scale Irrigation Investments

(Consequences of current activities and of alternatives)

Positive and negative impacts

- Direct and indirect impacts
- Short and long term impacts
- Unavoidable impacts
- Cumulative impacts
- Irreversible impacts

Cost benefit discussion

Irrigation implementation, environmental review and supervision

Cooperating Sponsors

- USAID

Federal and Regional Government Institutions

Monitoring and Mitigation

"Best Practices" for Small-Scale Irrigation

- Design criteria to avoid or mitigate environmental impact

Small-Scale Irrigation monitoring

Capacity Building

Preparation of manuals for Small Scale Irrigation

- Training of Cooperating Sponsor staff

Study Tours and Linkage with Indian irrigation experience

List of Preparers

Appendices

Annex A

Programmatic Environmental Assessment Scoping Team

Dr. Tom Remington, Regional Agriculture & Environment Advisor. Ph. D. Agronomy, University of Wisconsin. Assessed the impact of USAID-funded storage systems on women rice farmers in the Gambia. Over 20 years experience in farming systems research and extension, in Sub-Saharan Africa, South Asia, and Latin America. CRS/East Africa

Mr. Thomas Catterson, PEA Team Leader. Msc. International Forestry 1973. Independent International Consultant. Over 30 years of community oriented natural resources management experience, in over 65 countries. Focused experience with food aid, natural resources and environmental issues and procedures in Ethiopia, Eritrea, Cambodia, Niger, El Salvador and Peru. CRS

Ato Moges Worku, Project Officer, Agriculture and Natural Resources Management. Msc. in Soil & Water Engineering. Conducted research on soil erosion and watershed modeling. CRS manager of pilot irrigation activities in Dire Dawa. CRS/Ethiopia

Ato Getachew Alem, Project Officer, Potable Water Supply. Msc. in Engineering from the University of California - Davis and in Hydrology from the Free Univeristy of Brussels. Research on subsurface drainage design and run-off modeling in the Awash River basin. CRS/Ethiopia

Dr. Tedele Gebreselassie, Program Specialist, Agriculture and Natural Resources Office. Phd. Soil & Water Management, Utah State University. Thesis on reclamation of soil affected soils and irrigation water quality in the Awash valley. Over 12 years with the Institute of Agriculture Research in Soil and Water Management research activities. Managed the Melka Werer Irrigated Agriculture Research Station for six years. USAID/Ethiopia

Ms. Joy Shiferaw, Intern, Food and Humanitarian Assistance Office. Responsible for logistical and administrative details. Currently at Tufts University Fletcher School of Law and Diplomancy in development economics and environmental resource policy. USAID/Ethiopia

Annex B

People Consulted During the Scoping Process

Cooperating Sponsors Meetings: Aug. 3 & 13, 1998

Name/Position	Affiliation
Demissie Lisanwork, Technical Coordinator	FHI
Solomon Hailu, Irrigation Engineer	FHI
Endalkachew Getaneh, Co-Programs Director	FHI
Solomon Wolde, Irrigation Engineer	FHI
Kendie rufael Program Officer for Food Security	EOC
Abadi Amdu, Conservationist	EOC
Nassirou Ba, Environment Advisor/Food Security Advisor	SCF
John Hoare, DAP Coordinator	CARE
Sorrsa Natea, Project Coordinator, Shoa	CARE
Asnake Aberra, Agricultural Engineer	WVE
Merid Kebede, Coordinator	WVE
Moges Worku, Project Officer (Agriculture and Natural Resources Management)	CRS
Carrell Laurent Food For Peace Officer	USAID
Gessesse G/Medhim Fund Raising and External Relations	REST
Tillahun Amaha Acting Head Liaison Office	REST
Dorrett L. Byrd Country Representative	CRS
Getachew Alem, Project Officer (Water Supply)	CRS

Interviews in Addis Ababa

Name/Position	Affiliation
W/O Saba Kidanemariam, Deputy General Manager (acting)	ESRDF
Ato Gebeyehu Bizuneh, Small Scale Irrigation Team Leader	ESRDF
Ato Sintayehu Gebremariam, National Program Officer	FAO/Ethiopia
Ato Sisay Gebregiorgis, Staff Member (Chairman-Board- Action for Development NGO)	FAO/Ethiopia
Ato Yacob Likie, Consultant	FAO/Ethiopia

Ato Dessalegn Rahmeto, Director	Forum for Social Studies
Ato Abebe Wolde-Amanuel, Hydraulic Engineer	MOA
Ato Shekib Abdulhi, Irrigation Engineer	MOA
Dr. Tadese Bekele, Irrigation Agronomist	MOA
Eng. Gebreyes Haile, Director, Development Projects	LWF/Ethiopia
Ms. Camilla Madsen, Environment Consultant	LWF/Ethiopia
Mr. Douglas Clements, Food Policy Advisor	CIDA- PSU
W/O Haimanot Assefa, Environment Advisor	CIDA- PSU
Ato Tilahun Woldemichael, Head, Infectious and Other Diseases Research	Ethiopia Health and Nutrition Research Institute
Ato Gedion Asfaw, Technical Advisor	Secretariat, CSE-EPA
Ato Yonas, Team Leader, EIA Team	EPA
Ato Mulugetta Bezzabeh, Coordinator SAERP/WARDIS Program	UN ECA
Ato Negash Gemtessa, Head, Design Department	MWR
W/O Muna Haileselassie, Environmental Specialist	MWR
Ato Adugna, Irrigation Engineer	MWR
Ato Tarekegn Abose, Head, Malaria and Other Vector-borne Diseases Control Unit	Ministry of Health
W/O Bogalech, Gender Specialist	MOA
Ato Senbeta Issata, Acting Department Head	Environmental Protection and Land Use Planning
Ato Alemayehu Geleta, Senior Environmental Pollution Expert	Environmental Protection and Land Use Planning
Dr. Carmela Green-Abate, M.D., Chairperson	Gemini Trust

Others Met in the Field

Name/Position	Affiliation
Ato Tedla, Assistant Project Coordinator, Shoa	CARE
Ato Mesfin, Extensionist, Shoa- Doni Irrigation Scheme	CARE

Annex C

Relevant Literature

Anderson, I. and B. Flynn. "Small-scale irrigation in Ethiopia." In *Irrigation Theory and Practice; Proceedings of the International Conference Held at the University of South Hampton, September 12 to 15, 1989*. edited by J. R. Rydzewski and C. F. Ward, Pentech Press,1989.

Birley, M. H., *Guidelines for Forecasting the Vector-Borne Disease Implications of Water Resources Development*. PEEM Guidelines Series 2. WHO, 1989.

Burpee, G.; P. Harrigan; and T. Remington. *A Field Guide to USAID Environmental Compliance Procedures*. Washington, D.C.: Catholic Relief Services and Food Aid Management (FAM), March 1998.

Canadian Council for International Cooperation. Environmental Screening of NGO Development Projects – Small Dams/Reservoirs.

CARE, *Initial Environmental Examination–CARE-Ethiopia DAP Food and Livelihood Security Program*. Addis Ababa: CARE- Ethiopia, March 1998.

CIDA, *Handbook on Environmental Assessment of Non-Governmental Organizations and Institutions Programs and Projects*. Quebec: Canadian Partnership Branch, CIDA, October 1997.

CRS, *Initial Environmental Examination FY 99 PAA.* Addis Ababa: Catholic Relief Services–Ethiopia, April 1998.

Continental Consultants P.L.C. & Consulting Engineers (India), *ESRDF's Small-Scale Irrigation Projects Technical Handbook*, Components 1 to 10. Addis Ababa: Ethiopian Social Rehabilitation and Development Fund:1997.

Demeke, Tadella. *Guidelines to Enhance Women's Participation in Local Level Participatory Planning of Food-for-Work Activities*. Government of Ethiopia & World Food Programme. Project ETH 2488/3, 1997.

Demeke, Tadella.*Women's Participation in Project Planning*: A Review of WFP Supported FFW Projects in Ethiopia Draft, 1997.

EHNRI,*Annual Report 1989 E.C. (1996/97 G.C.)*. Addis Ababa: Ethiopian Health and Nutrition Research Institute, 1989.

Environmental Protection Authority and Ministry of Economic Development and Cooperation, *The Conservation Strategy of Ethiopia*, *Executive Summary*, Environmental Policy and Volumes 1 to 4. Addis Ababa, 1997.

EPA, *Environmental Impact Assessment Guideline–Volume I–Procedural Guideline*. Addis Ababa: Environmental Protection Authority, June 1997.

EPA, *EIA-Sectoral Guideline–Volume II–EIA Guideline for Agricultural Sector Development Projects*. Addis Ababa: Environmental Protection Authority, June 1997.

EOC, *Initial Environmental Examination (IEE)–DAP–FY 1998 to FY 2003*. Addis Ababa: Ethiopian Orthodox Church, Development and Inter-Church Aid Commission, July 1998.

ESRDF, *Environmental Checklist*. Addis Ababa: Ethiopian Social Rehabilitation and Development Fund, Central Office.

Field, W. P. and H. R. Collier, *Checklist to Assist Preparation of Small-Scale Irrigation Projects in Sub-Saharan Africa***.** UK Department for International Development International Commission on Irrigation and Drainage, 1998.

FHI, *Initial Environmental Examinatio(IEE)–DAP–FY 1999 to FY 2001*. Addis Ababa: Food for the Hungry International/Ethiopia, June 1998.

Getachew, Alem. *Irrigation Agriculture in Ethiopia-Challenges and Opportunities for Sustainable Development*. Addis Ababa: Ministry of Water Resources, June 1997.

Gordon, H.; A. Chiri; and Abate Tsedeke. *Environmental and Economic Review of Crop Protection and Pesticide Use in Ethiopia*. Prepared for

USAID/Ethiopia. Arlington, Virginia: Winrock International Environmental Alliance, November 1995.

Guijt, I. and J. Thompson. *Landscape and Livelihoods: Environmental and Socioeconomic Dimensions of Small-Scale Irrigation*. Land Use Policy 11 (4) 294-308, 1994.

Habtamu, Gessese. "Problems and Constraints in the Study, Construction and Management of Small-Scale Irrigation Projects," Paper No. S2-6. Presented at the National Irrigation Policy and Strategy Workshop, Addis Ababa, October 1990.

Lutheran World Federation, *Environmental Guidelines for Program Implementation*. Geneva, 1997.

PFRA, *Water Harvesting and Institutional Strengthening Tigray (WHIST)–Project Design Mission Report*. Quebec: Prairie Farm Rehabilitation Administration (Agriculture and Agri-Food Canada), March 1998.

Regional Council of the Amhara Regional State and the United Nations Economic Commission for Africa, *Sustainable Agriculture and Environmental Rehabilitation Program (SAERP). Basic Guide on Environmental Impact Assessment in Saerar Programme*, 1996.

Remington, T. *Strengthening Grant Supplement: Integrating FFW with Cash to Increase Impact on Food Security - A Change Request*.1998.

REST, *Initial Environmental Examination (IEE) DAP-FY 1999- 2003*. Mekelle: Relief Society of Tigray, July 1998.

Tiffen, M. *Guidelines for the Incorporation of Health Safeguards into Irrigation Projects through Intersectoral Cooperation*. PEEM Guidelines Series 1. WHO, 1991

Transitional Government of Ethiopia, *National Policy on Ethiopian Women***.** Addis Ababa: Office of the Prime Minister, 1993 .

UN/ECA, *Concepts and Implementation Arrangement of the Sustainable Agricultural and E**nviron**mental Rehabilitation Programme – Ethiopia*. Addis Ababa: Sustainable Agriculture and Environmental Rehabilitation Programme (SAERP), United Nations Economic Commission for Africa (UNDP/ECA Project ETH 94/001/01/99.

UN/ECA, *Policy Directions and Institutional Arrangements for the Implementation of the WARDIS Programme by the National Regional States of Ethiopia (Executive Summary)*. Sustainable Agriculture and Environmental Rehabilitation Programme (SAERP), The Wereda Agriculture and Rural Development Integrated Services (WARDIS), United Nations Economic Commission for Africa (UNDP/ECA Project ETH 94/001/01/99, October 1997.

UN/ECA, *Summary of 200 Field Program Oriented Technical Documents, Strategy Papers, Guidelines and Manuals Prepared by the SAERP/ WARDIS Programme*. Addis Ababa: Sustainable Agriculture and Environmental Rehabilitation Programme (SAERP), The Wereda Agriculture and Rural Development Integrated Services (WARDIS). United Nations Economic Commission for Africa (UNDP/ECA Project ETH 94/001/01/99, December 1997.

USAID, *Results Review and Resource Request (R4)-USAID/Ethiopia FY 2000*. Addis Ababa: USAID/Ethiopia,1998.

USAID, *Environmental Documentation Manual for P.L. 480 Title II Cooperating Sponsors Implementing Food-Aided Development Programs*. Washington, D.C.: USAID/AFR/SD and USAID/BHR/Food for Peace, January 1998.

USAID, *Environmental Guidelines for Small-Scale Activities in Africa- Environmentally Sound Design for Planning and Implementing Humanitarian and Development Activities*, Technical Paper 18, Washington, D.C.: USAID/AFR/SD, June 1996.

USAID, *Programmatic Environmental Assessment-Rural Road Rehabilitation Activities*. Antanarivo: USAID/Madagascar, August 1996.

USAID/Nepal, *Environmental Assessment of Irrigation Management Transfer Project Scoping Statement*. 1996.

Vincent, Linden, *Hill Irrigation: Water and Development in Mountain Agriculture*. London: Intermediate Technology Publications and Overseas Development Institute,1995.

World Bank, *Environmental Assessment Sourcebook. Volume 2: Sectoral Guidelines*. World Bank Technical Paper Number 140,1991

World Bank Environmental Department, *Health Aspects of Environmental Assessment*. Sourcebook Update Number 18,1997

World Bank Environmental Department, *Environmental Hazard and Risk Assessment.* Sourcebook Update Number 21, 1997.

World Bank, *Environmental Assessment Sourcebook. Volume 1: Policies, Procedures and Cross-Sectoral Issues*. World Bank Technical Paper Number 139, 1991.

WVI/Ethiopia, *FY 99 Previously Approved Activity (PAA) Initial Environmental Examination for FY 99*. Addis Ababa: World Vision International/Ethiopia, April 1998.

Annex D

Small-Scale Irrigation & Reservoirs: Problem Ranking

Problem	Rank
Loss of fisheries	1.40
Loss of cultural heritage (archeological and historical sites)	1.55
Increased work load of women	1.85
Disruption of traditional cropping systems	1.95
Wetlands destruction	1.95
Increase in weed pressure	2.00
Increased agrochemical contamination	2.05
Disruption of livestock systems	2.05
Failure to achieve production targets	2.05
Dislocation due to construction	2.15
Increase in crop pests (diseases and insects)	2.30
Persons located outside the site relocating to the site	2.35
Failure to complete system (i.e. secondary canals)	2.37
Lack of credit for inputs	2.45
Damage to system from livestock traffic	2.55
Loss of water from seepage and evaporation	2.60
Difficulty in land leveling	2.60
Waterlogging	2.60
Soil salinization	2.65
Increase in diarrhea and other illnesses due to drinking reservoir and canal water	2.75
Lack of access to markets	2.80
Erosion or sedimentation of canals	2.80
Poor water distribution	2.80
Difficulty of communities in operation and maintenance of systems	2.85
Less water for downstream users	3.00
Increase incidence of vector borne diseases	3.00
Inequitable allocation of irrigated plots	3.05
Faulty design and construction	3.05
Siltation of reservoirs	3.21
Lack of hydrologic data for planning	3.25

n = 20

1 - Not a Problem 2 - Minor Problem 3 - Somewhat Serious Problem 4 - Serious Problem

Appendix B

Brief Biographical Sketches of the PEA Team and Scopes of Work for Full-Time Team Members

Mr. Thomas Catterson, PEA Team Leader. Msc. International Forestry 1973. Independent International Consultant. Over 30 years of community oriented natural resources management experience, in over 65 countries around the globe. Focused experience with food aid, natural resources and environmental issues and procedures in Ethiopia, Eritrea, Cambodia, Niger, El Salvador and Peru.

Ato Moges Worku, Deputy PEA Team Leader/ Soil and Water Conservation Specialist. Project Officer, Agriculture and Natural Resources Management. Msc. in Soil and Water Engineering. Conducted research on soil erosion and watershed modeling. CRS manager of pilot irrigation activities in Dire Dawa.

Ato Messele Endalew, Rural Sociologist/Community Institutions Specialist. Project Officer, CRS/Ethiopia. MA in Rural Development, University of East Anglia, UK. Over 10 years with Ministry of Agriculture/Irrigation Development Department as senior sociologist. Extensive experience in assessing socio-economic aspects of small-scale irrigation schemes. MA thesis on problems and prospects of small-scale irrigation development in Ethiopia.

Dr. Carmela Green Abate, Community/Environmental Health Specialist. Independent Consultant. Over 20 years experience in child health in Ethiopia at tertiary and primary levels from teaching, clinical and research perspectives. Six years experience as Senior Technical Advisor for Health in USAID/Ethiopia, with management oversight of primary and preventive rural health programs and HIV/AIDS. Fifteen years experience in the NGO sector, primarily with an indigenous NGO. International research links with universities in the U.K. and U.S.

Dr. Frank Brockman, Crop Scientist. Agriculture/Environment Technical Advisor, CRS/Baltimore. PhD. Crop Science, Cornell University, 1974. Twenty-four years international experience (sub-Saharan Africa, Caribbean, Asia) in agronomic research, management of agricultural research and extension projects, and provision of technical support for agricultural development.

Ato Abebe Wolde Amanuel, Irrigation Engineering Specialist. Bsc. in Civil Engineering from Addis Ababa University, Faculty of Technology. Post-Graduate Degree in upland hydraulics from IHE, Delft, the Netherlands. Certificate in high dam design from Japan. More than 17 years of experience at the Ministry of Agriculture in the planning, study, design and construction of various types of hydraulic structures for small-scale irrigation projects.

Ato Kibru Mamusha, Economics/Financial Assessment Specialist. Project Officer, Agricultural Credit with CRS/ Ethiopia. Msc. in Agricultural Economics, Wye College, University of London, Thesis on farm labor use and productivity in the major coffee growing areas of Ethiopia. Extensive experience in the design, planning and evaluation of rural development projects.

Scope of Work for PEA Team Leader/ Environmental Review Specialist

Purpose

To carry out and serve as team leader for a programmatic assessment and environmental review of small-scale irrigation and related activities (including slope modification and small-scale reservoirs) of Title II programs in Ethiopia, Guatemala and India, in order to comply with USAID environmental regulations, as outlined in Reg. 216, and to generate environmentally sound guidelines for the larger PVO community.

Background

USAID PL 480 Title II programs are being required to come into compliance with USAID environmental regulations under Reg. 216. All CRS Title II countries must review their activities and submit Initial Environmental Examinations for USAID mission and bureau clearance under Reg. 216. CRS lacks internal resources to carry out the required environmental reviews of irrigation activities in the many CRS countries where small-scale irrigation is implemented.

Reg. 216 was written in an era when irrigation, implemented as part of development projects, was almost always large-scale and was therefore defined in Reg. 216 as an activity that "normally has a significant negative impact on the environment." While the focus of PVO development has shifted to small-scale agriculture and the definition of irrigation in development has also changed, it is important for the PVO community to ascertain whether and under what conditions small-scale irrigation has a negative environmental impact. This information can then be used to develop guidelines that avoid, minimize or mitigate negative environmental, socio-economic, etc. impacts, while enhancing the potential positive effects.

Work to be Accomplished

The Team Leader will:

1. Coordinate and supervise the work of an environmental review team for a Programmatic Environmental Assessment (PEA) involving the three countries listed above. The disciplinary make-up of the PEA review team will be determined as part of an approximately two-week "scoping process," but the review team will most likely consist of a community development/rural finance specialist, an agricultural engineer and an irrigation specialist.

2. Take part in selection of Environmental Assessment review team members.

3. Serve as Team Leader for the "scoping process," which will be used to inform and detail the Scope of Work for each country. Scoping will begin in Ethiopia and will involve a scoping team consisting of one CRS Headquarters or Regional Technical Advisor for Agriculture/Environment; one or more USAID Mission, Regional or Washington environmental officers; other relevant Cooperating Sponsors and appropriate CRS in-country and counterpart staff.

   The Scope of the PEA, and the framework for the scoping process will be developed collaboratively by those involved in the scoping process. Among the most salient questions that will be addressed during the scoping and PEA process are the following:

   - Under what conditions is irrigation technically feasible?
   - What influences the profitability of investment in irrigation?
   - What are the technical, social, economic and environmental issues to address in irrigation planning?
   - What are the social impacts, both positive and negative, of irrigation? What is the role of local communities in small-scale irrigation projects?
   - What are the health impacts of irrigation—both positive and negative? (Positive relates to increased income, food availability and nutrition.)
   - What are appropriate monitoring activities and mitigation measures?

4. The PEA SOW in each country will be guided by results of the scoping process. At a minimum, the

SOW will include the following activities:

- Review the most recent and relevant environmental assessments of small-scale irrigation conducted by USAID, World Bank and others. Compile a list of references and resources.
- For each country, review the national and regional irrigation and environmental regulations and procedures to include legislative and regulatory.
- Identify the team that will carry out the PEA. Develop a PEA plan of action with budget. Carry out the PEA.
- Analyze the performance of the Cooperating Sponsor irrigation sector to include the locations of irrigation, the types of planning being carried out and the apparent impact and cost effectiveness of the investments.
- Develop a classification of small-scale irrigation in Ethiopia (that might be applied elsewhere or adapted for the other countries of this assessment exercise) based on the following parameters:

  – size of the undertaking

  – elevation

  – source of water

  – crops cultivated

  – reservoir present or absent

  – permanent or seasonal irrigation

  – new or rehabilitated scheme
- Determine the actual and potential impacts (both positive and negative, direct and indirect, immediate and long-term) of small-scale irrigation. Identify impacts that are unavoidable or irreversible. Where possible, describe impacts quantitatively and in terms of costs and benefits.
- Conduct an analysis of alternative irrigation investments as well as alternatives to investment in irrigation.
- Develop recommendations for management planning related to mitigation of the negative social and environmental impacts of small-scale irrigation.
- Identify the institutional and support needs of Cooperating Sponsors at the local, regional and national level. This should include recommendations for inter-Cooperating Sponsors coordination and support.
- Develop recommendations for a monitoring plan for irrigation with a focus on environmental monitoring.
- Prepare three concise country-specific reports, or volumes, of the environmental assessments that focus on findings, conclusions and recommended actions.
- Prepare one volume of general guidelines (with examples of each country case study) for use in the design and implementation of PVO small-scale irrigation programs worldwide. The summary volume will identify the conditions under which small-scale irrigation activities would be categorized in a Reg. 216 Initial Environmental Examination as a Negative Determination with/without conditions or as a Positive Determination requiring an Environmental Assessment.

5. Guide the three PEA teams in the study/review of the above topics and produce related documentation, listed in the Deliverables section below.
6. Attend the CRS Agriculture Symposium in Nairobi proposed for September 1998; conduct two to three hour seminar on environmental review of agricultural activities and contribute to working group that will be producing a chapter on Environmental Review for a CRS Agriculture Program Manual.
7. Make field visits as appropriate to India (two to three), Guatemala (two) and Ethiopia (three) to review and evaluate current irrigation practices.
8. Consult with relevant counterpart/CRS staff in the field. Consult with the following CRS Environmental Review support teams, formed for the purpose of this consultancy.

For Ethiopia

- Regional Coordinator- Tom Remington EARO Agriculture & Environment Advisor
- CRS/Ethiopia Coordinators- Moges Worku & Getachew Alem
- Ethiopia irrigation specialist- Ministry of Agriculture identified

- Health linkage specialist- CRS/Ethiopia Health Advisor
- Monitoring Specialist- Kari Egge CRS/Ethiopia M&E Specialist

For India

- Regional Coordinator- Gaye Burpee PQSD Agriculture & Environment Specialist
- CRS/India Coordinator- Lori Kunze CRS/India Program Quality Specialist
- India small-scale irrigation specialist- AFPRO identified
- Health linkage specialist- CRS/India Health Advisor
- Monitoring Specialist- T.D.Jose CRS/India M&E Specialist

For Guatemala

- Regional Coordinator- Gaye Burpee PQSD Agriculture & Environment Specialist
- CRS/Guatemala Coordinator- Ed Walters Regional Agriculture Technical Advisor
- Guatemala small-scale irrigation specialist- Ministry of Agriculture identified
- Health Linkage Specialist- CRS/Guatemala Health Advisor
- Monitoring Specialist - to be identified

Place of Performance

Work will be performed at field sites in Ethiopia, India, Guatemala, a U.S. based site convenient to the consultant and Nairobi.

Period of Performance

The consultant will work for CRS as needed between 27 July 1998 and March 1999.

Deliverables

First draft of documents containing the information contained below will be submitted to the CRS PQSD Agriculture/Environment Technical Advisor for headquarters and field review by 1 February 1999. Final drafts will be submitted to the Director of Program Quality Support Department by 7 March 1999.

The team leader will produce documents in the form of three country-specific volumes and one summary volume, in collaboration with team members where appropriate. Documents will contain the following:

a. Technical and cross-sectoral guidance for CRS Title II small-scale irrigation and related activities.

b. Guidance on conditions under which small-scale irrigation activities qualify for a Reg. 216 "Negative Determination with/without Conditions" and when they require a "Positive Determination."

c. Guidance on applying mitigative measures as a condition of a negative determination.

d. Guidance on performance output, impact and environmental indicators.

e. Recommendations for monitoring plans, focusing on environmental aspects.

f. Screening lists of potential positive and negative environmental impacts of small-scale irrigation activities.

g. Guidance for the creation of sustainable rural finance institutions linked to investment in small-scale irrigation.

h. Classification of small-scale irrigation activities.

i. Analysis of alternative irrigation investments and discussion of alternatives to small-scale irrigation, such as in-situ water conservation.

Contact Persons

Dr. Gaye Burpee
Agriculture/Environment Program Quality Support
Catholic Relief Services
209 West Fayette Street
Baltimore, Maryland 21201-3443
Tel: 410-625-2220, ext. 3451
FAX: 410-234-3182
Email: gburpee@catholicrelief.org

Dr. Tom Remington
Agriculture & Environment
Catholic Relief Services/East Africa
P.O. Box 49675
Nairobi, Kenya
Tel: 254-2-74-13-55
Email: agric-ea@form-net.com

Scope of Work for PEA Irrigation Engineer

Introduction and Purpose

The Irrigation Engineer will work under the direct supervision of the Team Leader as an integral member of a seven person interdisciplinary team carrying out the USAID/CRS Programmatic Environmental Assessment (PEA) of Small-Scale Irrigation (SSI). These SSI activities are among those presently being carried out with rural communities throughout Ethiopia by the Cooperating Sponsors and supported by PL 480 Title II food aid resources.

In general, the Team will carry out the assessment activities described in the 30 September 1998 Scoping Statement prepared as a prelude to this PEA. These will include: reading and review of relevant documentation, an on-going series of team meetings, site visits and data collection throughout the country, and interviews with key stakeholders in the capital and in the regions. The purpose of the PEA is to develop guidance and build capabilities for the improved identification, design, construction, operation and maintenance of increasingly sustainable (environmentally sound, economically viable and socially acceptable) small-scale irrigation schemes.

It is important to emphasize that this PEA is not an environmental performance evaluation but rather a program level effort to identify key lessons learned from real field experience with small-scale irrigation in Ethiopia. In order to be fully successful, the methodology of the team should be interactive and collaborative with the full range of stakeholders who will be asked to give their frank assessments of the sustainability of SSI.

Team Member Duties and Responsibilities (General)

In order to facilitate the interdisciplinary nature of the team work required for the efficient conduct of this PEA, each individual team member will be responsible for the following tasks:

- Review the existing literature, both Ethiopia-specific and beyond, with the goal of developing **an annotated list of relevant references (product 1)** pertinent to their particular specialized area;
- On the basis of their knowledge of state-of-the-art SSI in Ethiopia, develop **a set of key questions (product 2)** that will be essential to their part of the analysis for the PEA, discuss and revise these questions with the team leader and other team members, in preparation of a field site visit protocol;
- Ensure that these key questions are discussed during field visits, as pertinent, with CS personnel, community and/or irrigation committee members and where possible, with local government representatives, in order to gather the data for their specific analyses; and
- Contributing to the consultative process essential to the satisfactory conduct of this PEA by taking the lead in identifying other individuals (relevant government, non-governmental, cooperating sponsor and donor personnel), as concerns his/her particular specialized area, and maintain a record of those interviewed for inclusion in the PEA report as corroboration of public consultation.

Team Member Duties and Responsibilities (Specific)

In addition to these generic activities, the Soil and Water Conservation Specialist will assume a leadership role in investigating the soil and water conservation aspects of small-scale irrigation in Ethiopia and their importance in achieving sustainable investments and developments, with special reference to the following (see to the List of Issues – Section 3.4.1 in the PEA Scoping Statement for further detail):

- Description and classification of small-scale irrigation systems;
- Role of and methodology for obtaining hydrological data for planning and hydrological monitoring during scheme operations;
- Key irrigation engineering opportunities associated with upgrading or rehabilitating traditional small-scale irrigation schemes;
- Role of integrated watershed management in SSI design and maintenance (especially as concerns

flood and sedimentation mitigation);

- Identification of irrigation engineering related issues typical of the small, farmer-managed irrigation schemes being assessed;

- Indicative costs for irrigation engineering needs as a component of cost/benefit analysis;

- Prepare a series of conclusions and recommendations ("guidance") on how to avoid, address, mitigate and monitor for these issues so as to improve the sustainability of small-scale irrigation investments and developments; and

- Human resources development and institutional capacity needs for small-scale irrigation related engineering.

Most importantly, the Irrigation Specialist will be responsible for discussing his findings with other team members so as to contribute to and stimulate his preparations (and those of other team members) of those portions of **a synthesis report related to his particular specialized area (product no. 3)** as a contribution to the preparation of a draft PEA. This synthesis report will be prepared in accordance with the outline of the PEA as found in section 4.4 of the Scoping Statement. Prior to preparing the individual report, **the irrigation specialist will discuss an outline of same with the team leader and other team members** as appropriate.

In addition, the Irrigation Engineer will **carry out any other irrigation engineering related studies and activities as may be identified** and agreed in consultation with the team leader during the study process.

Milestones

Product 1:	Annotated Relevant References; first draft, November 15; final draft, December 12
Product 2:	Set of Key Questions; first draft November 6; final draft, November 14
Product 3:	Irrigation Engineering Synthesis Report; outline, end-November; first draft, December 9; final, December 12

Performance Period

The consultancy will begin on or about 3 November 1998 and terminate on 12 December 1998 for a total of six weeks. The total number of days of the consultancy, assuming six day work weeks (working on Saturdays) will not exceed 36.

Contact Persons

The consultant will work under the programmatic supervision of the PEA Team Leader, Mr. Tom Catterson. The contact person for administrative and contractual matters will be the CRS/Ethiopia Country Representative, Ms. Dorrett Lyttle Byrd.

Duty Station and Duration

See attached Ethiopia PEA Draft Schedule.

Scope of Work for PEA Community/ Environmental Health Specialist

Introduction and Purpose

The Community/Environmental Health Specialist will work under the direct supervision of the Team Leader as an integral member of a seven person interdisciplinary team carrying out the USAID/CRS Programmatic Environmental Assessment (PEA) of Small-Scale Irrigation (SSI). These SSI activities are among those presently being carried out with rural communities throughout Ethiopia by the Cooperating Sponsors and supported by PL 480 Title II food aid resources.

In general, the Team will carry out the assessment activities described in the 30 September 1998 Scoping Statement prepared as a prelude to this PEA. These will include: reading and review of relevant documentation, an on-going series of team meetings, site visits and data collection throughout the country, and interviews with key stakeholders in the capital and in the regions. The purpose of the PEA is to develop guidance and build capabilities for the improved identification, design, construction, operation and maintenance of increasingly sustainable (environmentally sound, economically viable and socially acceptable) small-scale irrigation schemes.

It is important to emphasize that this PEA is not an environmental performance evaluation but rather a program level effort to identify key lessons learned from real field experience with small-scale irrigation in Ethiopia. In order to be fully successful, the methodology of the team should be interactive and collaborative with the full range of stakeholders who will be asked to give their frank assessments of the sustainability of SSI.

Team Member Duties and Responsibilities (General)

In order to facilitate the interdisciplinary nature of the team work required for the efficient conduct of this PEA, each individual team member will be responsible for the following tasks:

- Review the existing literature, both Ethiopia-specific and beyond, with the goal of developing **an annotated list of relevant references (product 1)** pertinent to their particular specialized area;
- On the basis of their knowledge of the State of the Art of SSI in Ethiopia, develop **a set of key questions (product 2)** that will be essential to their part of the analysis for the PEA, discuss and revise these questions with the team leader and other team members, in preparation of a field site visit protocol;
- Ensure that these key questions are discussed during field visits, as pertinent, with CS personnel, community and/or irrigation committee members and where possible, with local government representatives, in order to gather the data for their specific analyses; and
- Contributing to the consultative process essential to the satisfactory conduct of this PEA by taking the lead in identifying other individuals (relevant government, non-governmental, cooperating sponsor and donor personnel), as concerns his/her particular specialized area, and maintain a record of those interviewed for inclusion in the PEA report as corroboration of public consultation.

Team Member Duties and Responsibilities (Specific)

In addition to these generic activities, the Community/ Environmental Health Specialist will assume a leadership role in investigating the human health aspects of small-scale irrigation in Ethiopia and their importance in achieving sustainable investments and developments, with special reference to the following (refer to the List of Issues – Section 3.4.1 in the PEA Scoping Statement for further detail):

- Assessment of the incidences of vector borne, water borne and water contact diseases associated with the development of small-scale irrigation;
- Small-scale irrigation related health baseline study methodologies as a foundation for environmental health monitoring;
- Mitigation measures for avoiding environmental health impacts, including: irrigation engineering recommendations, human behavior modification, water and health education, etc.;

- Household food security improvements from diversified diet possible through irrigated agriculture, including women's views of this topic;
- Linkages between safe water and irrigation; and
- Human resources development and training and institutional capability needs related to environmental health.

Most importantly, the Community/Environmental Health Specialist will be responsible for discussing her findings with other team members so as to contribute to and stimulate her preparations of those portions of **a synthesis report related to his particular specialized area (product 3)** as a contribution to the preparation of a draft PEA. This synthesis report will be prepared in accordance with the outline of the PEA as found in section 4.4 of the Scoping Statement. Prior to preparing the individual report, **the specialist will discuss an outline of same with the team leader and other team members** as appropriate.

In addition, the Community/Environmental Health Specialist will **carry out any other health related studies and activities as may be identified** and agreed in consultation with the team leader during the study process.

Milestones

Product 1:	Annotated Relevant References; first draft, November 15; final draft, December 12
Product 2:	Set of Key Questions; first draft November 6; final draft, November 14
Product 3:	Irrigation Engineering Synthesis Report; outline, end-November; first draft, December 9; final, December 12

Performance Period

The consultancy will begin on or about 6 November 1998 and terminate on 12 December 1998 for a total of six weeks. The total number of days of the consultancy, assuming six day work weeks (working on Saturdays) will not exceed 36.

Contact Persons

The consultant will work under the programmatic supervision of the PEA Team Leader, Mr. Tom Catterson. The contact person for administrative and contractual matters will be the CRS/Ethiopia Country Representative, Ms. Dorrett Lyttle Byrd.

Duty Station and Duration

See attached Ethiopia PEA Draft Schedule.

Scope of Work for PEA Economics/ Financial Assessment Specialist

Introduction and Purpose

The Economics/Financial Assessment Specialist will work under the direct supervision of the Team Leader as an integral member of a seven person interdisciplinary team carrying out the USAID/CRS Programmatic Environmental Assessment (PEA) of Small-Scale Irrigation (SSI). These SSI activities are among those presently being carried out with rural communities throughout Ethiopia by the Cooperating Sponsors and supported by PL 480 Title II food aid resources.

In general, the Team will carry out the assessment activities described in the 30 September 1998 Scoping Statement prepared as a prelude to this PEA. These will include: reading and review of relevant documentation, an on-going series of team meetings, site visits and data collection throughout the country, and interviews with key stakeholders in the capital and in the regions. The purpose of the PEA is to develop guidance and build capabilities for the improved identification, design, construction, operation and maintenance of increasingly sustainable (environmentally sound, economically viable and socially acceptable) small-scale irrigation schemes.

It is important to emphasize that this PEA is not an environmental performance evaluation but rather a program level effort to identify key lessons learned from real field experience with small-scale irrigation in Ethiopia. In order to be fully successful, the methodology of the team should be interactive and collaborative with the full range of stakeholders who will be asked to give their frank assessments of the sustainability of SSI.

Team Member Duties and Responsibilities (General)

In order to facilitate the interdisciplinary nature of the team work required for the efficient conduct of this PEA, each individual team member will be responsible for the following tasks:

- Review the existing literature, both Ethiopia-specific and beyond, with the goal of developing **an annotated list of relevant references (product 1)** pertinent to their particular specialized area;
- On the basis of their knowledge of the State of the Art of SSI in Ethiopia, develop **a set of key questions (product 2)** that will be essential to their part of the analysis for the PEA, discuss and revise these questions with the team leader and other team members, in preparation of a field site visit protocol;
- Ensure that these key questions are discussed during field visits, as pertinent, with CS personnel, community and/or irrigation committee members and where possible, with local government representatives, in order to gather the data for their specific analyses; and
- Contributing to the consultative process essential to the satisfactory conduct of this PEA by taking the lead in identifying other individuals (relevant government, non-governmental, cooperating sponsor and donor personnel), as concerns his/her particular specialized area, and maintain a record of those interviewed for inclusion in the PEA report as corroboration of public consultation.

Team Member Duties and Responsibilities (Specific)

In addition to these generic activities, the Economics/ Financial Assessment Specialist will assume a leadership role in investigating the economics and financial aspects of small-scale irrigation in Ethiopia and their importance in achieving sustainable investments and developments, with special reference to the following (refer to the List of Issues - Section 3.4.1 in the PEA Scoping Statement for further detail):

- Small-scale irrigation as a viable food security strategy for Ethiopia (macro sector analysis);
- Title II funded small-scale irrigation activities and the strategies of Regional Sustainable Agriculture and Environmental Rehabilitation units and plans;
- Cost/Benefit analysis modeling for small-scale irrigation- both methodology and application to the field sites being sampled;
- Market access and marketing opportunities-

captured or not and related needs;

- Beneficiary household finance and small-scale irrigation- investments/capital accumulation/asset creation—getting ahead financially;
- Investments or dependency on programs and why/why not?;
- Costs and cost-sharing experience for operations and maintenance of SSI schemes;
- Labor issues in SSI including gender and household considerations;
- Access to credit and agricultural inputs as keys to sustainability;
- Achieving improved financial returns to beneficiaries of small-scale irrigation; and
- Human resources development and institutional capacity needs associated with economic and financial analysis.

Most importantly, the Economics/Financial Assessment Specialist will be responsible for discussing his findings with other team members so as to contribute to and stimulate his preparations (and those of other team members) of those portions of **a synthesis report related to his particular specialized area (product 3)** as a contribution to the preparation of a draft PEA. This synthesis report will be prepared in accordance with the outline of the PEA as found in section 4.4 of the Scoping Statement. Prior to preparing the individual report, **the specialist will discuss an outline of same with the team leader and other team members** as appropriate.

In addition, the Economics/Financial Assessment Specialist will **carry out any other economics/financial management related studies and activities as may be identified** and agreed in consultation with the team leader during the study process.

Milestones

Product 1:	Annotated Relevant References; first draft, November 15; final draft, December 12
Product 2:	Set of Key Questions; first draft November 6; final draft, November 14
Product 3:	Irrigation Engineering Synthesis Report; outline, end-November; first draft, December 9; final, December 12

Performance Period

The consultancy will begin on or about 6 November 1998 and terminate on 12 December 1998 for a total of six weeks. The total number of days of the consultancy, assuming six day work weeks (working on Saturdays) will not exceed 36.

Contact Persons

The consultant will work under the programmatic supervision of the PEA Team Leader, Mr. Tom Catterson. The contact person for administrative and contractual matters will be the CRS/Ethiopia Country Representative, Ms. Dorrett Lyttle Byrd.

Duty Station and Duration

See attached Ethiopia PEA Draft Schedule.

Scope of Work for PEA Soil and Water Conservation Specialist

Introduction and Purpose

The Soil and Water Conservation Specialist will work under the direct supervision of the Team Leader as an integral member of a seven person interdisciplinary team carrying out the USAID/CRS Programmatic Environmental Assessment (PEA) of Small-Scale Irrigation (SSI). These SSI activities are among those presently being carried out with rural communities throughout Ethiopia by the Cooperating Sponsors and supported by PL 480 Title II food aid resources.

In general, the Team will carry out the assessment activities described in the 30 September 1998 Scoping Statement prepared as a prelude to this PEA. These will include: reading and review of relevant documentation, an on-going series of team meetings, site visits and data collection throughout the country, and interviews with key stakeholders in the capital and in the regions. The purpose of the PEA is to develop guidance and build capabilities for the improved identification, design, construction, operation and maintenance of increasingly sustainable (environmentally sound, economically viable and socially acceptable) small-scale irrigation schemes.

It is important to emphasize that this PEA is not an environmental performance evaluation but rather a program level effort to identify key lessons learned from real field experience with small-scale irrigation in Ethiopia. In order to be fully successful, the methodology of the team should be interactive and collaborative with the full range of stakeholders who will be asked to give their frank assessments of the sustainability of SSI.

Team Member Duties and Responsibilities (General)

In order to facilitate the interdisciplinary nature of the team work required for the efficient conduct of this PEA, each individual team member will be responsible for the following tasks:

- Review the existing literature, both Ethiopia-specific and beyond, with the goal of developing **an annotated list of relevant references (product 1)** pertinent to their particular specialized area;
- On the basis of their knowledge of the State of the Art of SSI in Ethiopia, develop **a set of key questions (product 2)** that will be essential to their part of the analysis for the PEA, discuss and revise these questions with the team leader and other team members, in preparation of a field site visit protocol;
- Ensure that these key questions are discussed during field visits, as pertinent, with CS personnel, community and/or irrigation committee members and where possible, with local government representatives, in order to gather the data for their specific analyses; and
- Contributing to the consultative process essential to the satisfactory conduct of this PEA by taking the lead in identifying other individuals (relevant government, non-governmental, cooperating sponsor and donor personnel), as concerns his/her particular specialized area, and maintain a record of those interviewed for inclusion in the PEA report as corroboration of public consultation.

Team Member Duties and Responsibilities (Specific)

In addition to these generic activities, the Soil and Water Conservation Specialist will assume a leadership role in investigating the soil and water conservation aspects of small-scale irrigation in Ethiopia and their importance in achieving sustainable investments and developments, with special reference to the following (refer to the List of Issues - Section 3.4.1 in the PEA Scoping Statement for further detail):

- Water use and water conservation practices and opportunities with small-scale irrigation;
- Soil conservation practices (on-farm/field) for SSI;
- Role of integrated watershed management in SSI design and maintenance (especially as concerns flood and sedimentation mitigation);
- Farmer willingness/interest in soil and water conservation investments and their costings as a component of cost/benefit analysis;

- Potential problems with salinization and waterlogging in these SSI schemes and how to avoid them;
- Identification of soil and water conservation related issues typical of the small, farmer-managed irrigation schemes being assessed;
- Prepare a series of conclusions and recommendations ("guidance") on how to avoid, address, mitigate and monitor for these issues so as to improve the sustainability of small-scale irrigation investments and developments; and
- Human resources development and institutional capacity needs for small-scale irrigation related rural sociology, popular participation and community organization methods.

Most importantly, the Soil and Water Conservation Specialist will be responsible for discussing his findings with other team members so as to contribute to and stimulate his preparations (and those of other team members) of those portions of **a synthesis report related to his particular specialized area (product 3)** as a contribution to the preparation of a draft PEA. This synthesis report will be prepared in accordance with the outline of the PEA as found in section 4.4 of the Scoping Statement. Prior to preparing the individual report, **the soil and water conservation specialist will discuss an outline of same with the team leader and other team members** as appropriate.

In addition, the Soil and Water Conservation Specialist will **carry out any other soil and water conservation related studies and activities as may be identified** and agreed in consultation with the team leader during the study process.

Milestones

Product 1:	Annotated Relevant References; first draft, November 15; final draft, December 12
Product 2:	Set of Key Questions; first draft November 6; final draft, November 14
Product 3:	Irrigation Engineering Synthesis Report; outline, end-November; first draft, December 9; final, December 12

Performance Period

The consultancy will begin on or about 6 November 1998 and terminate on 12 December 1998 for a total of six weeks. The total number of days of the consultancy, assuming six day work weeks (working on Saturdays) will not exceed 36.

Contact Persons

The consultant will work under the programmatic supervision of the PEA Team Leader, Mr. Tom Catterson. The contact person for administrative and contractual matters will be the CRS/Ethiopia Country Representative, Ms. Dorrett Lyttle Byrd.

Duty Station and Duration

See attached Ethiopia PEA Draft Schedule.

Scope of Work for PEA Rural Sociologist/Community Institutions Specialist

Introduction and Purpose

The Rural Sociologist/Community Institutions Specialist will work under the direct supervision of the Team Leader as an integral member of a seven person interdisciplinary team carrying out the USAID/CRS Programmatic Environmental Assessment (PEA) of Small-Scale Irrigation (SSI). These SSI activities are among those presently being carried out with rural communities throughout Ethiopia by the Cooperating Sponsors and supported by PL 480 Title II food aid resources.

In general, the Team will carry out the assessment activities described in the 30 September 1998 Scoping Statement prepared as a prelude to this PEA. These will include: reading and review of relevant documentation, an on-going series of team meetings, site visits and data collection throughout the country, and interviews with key stakeholders in the capital and in the regions. The purpose of the PEA is to develop guidance and build capabilities for the improved identification, design, construction, operation and maintenance of increasingly sustainable (environmentally sound, economically viable and socially acceptable) small-scale irrigation schemes.

It is important to emphasize that this PEA is not an environmental performance evaluation but rather a program level effort to identify key lessons learned from real field experience with small-scale irrigation in Ethiopia. In order to be fully successful, the methodology of the team should be interactive and collaborative with the full range of stakeholders who will be asked to give their frank assessments of the sustainability of SSI.

Team Member Duties and Responsibilities (General)

In order to facilitate the interdisciplinary nature of the team work required for the efficient conduct of this PEA, each individual team member will be responsible for the following tasks:

- Review the existing literature, both Ethiopia-specific and beyond, with the goal of developing **an annotated list of relevant references (product 1)** pertinent to their particular specialized area;
- On the basis of their knowledge of the State of the Art of SSI in Ethiopia, develop **a set of key questions (product 2)** that will be essential to their part of the analysis for the PEA, discuss and revise these questions with the team leader and other team members, in preparation of a field site visit protocol;
- Ensure that these key questions are discussed during field visits, as pertinent, with CS personnel, community and/or irrigation committee members and where possible, with local government representatives, in order to gather the data for their specific analyses; and
- Contributing to the consultative process essential to the satisfactory conduct of this PEA by taking the lead in identifying other individuals (relevant government, non-governmental, cooperating sponsor and donor personnel), as concerns his/her particular specialized area, and maintain a record of those interviewed for inclusion in the PEA report as corroboration of public consultation.

Team Member Duties and Responsibilities (Specific)

In addition to these generic activities, the Rural Sociologist/Community Institutions Specialist will assume a leadership role in investigating the all important community and beneficiary participation and organization aspects of small-scale irrigation in Ethiopia and their importance in achieving sustainable investments and developments, with special reference to the following (refer to the List of Issues - Section 3.4.1 in the PEA Scoping Statement for further detail):

- The present status of farmer (men and women) participation in the planning, design, construction, and operations and maintenance with the small-scale irrigation activities typically being carried out under the Title II program;

- The evolution of water user committees and similar community organizations for SSI;
- Farmer satisfaction with these activities and the returns on their efforts (for both men and women);
- Farmer willingness/interest and initiative for small-scale irrigation investments (any spontaneous replication, proper operations and maintenance, cost sharing arrangements at the community level);
- Land tenure and water usage rights issues associated with SSI;
- Relationships between local schemes and regional and national governmental authorities;
- Conflicts and their resolution, within the user group, among community members, with adjacent communities or other users;
- The level of women's involvement and participation in these activities and their views of the performance of these schemes;
- Identification of popular participation, beneficiary involvement and community organization related issues typical of the small, farmer-managed irrigation schemes being assessed;
- Prepare a series of conclusions and recommendations ("guidance") on how to avoid, address, mitigate and monitor for these issues so as to improve the sustainability of small-scale irrigation investments and developments; and
- Human resources development and institutional capacity needs for small-scale irrigation related rural sociology, popular participation and community organization methods.

Most importantly, the Rural Sociologist/Community Institutions Specialist will be responsible for discussing his findings with other team members so as to contribute to and stimulate his preparations (and those of other team members) of those portions of **a synthesis report related to his particular specialized area (product 3)** as a contribution to the preparation of a draft PEA. This synthesis report will be prepared in accordance with the outline of the PEA as found in section 4.4 of the Scoping Statement. Prior to preparing the individual report, **the Rural Sociologist/Community Institutions Specialist will discuss an outline of same with the team leader and other team members** as appropriate.

In addition, the Rural Sociologist/Community Institutions Specialist will **carry out any other community dimensions and popular participation related studies and activities as may be identified** and agreed in consultation with the team leader during the study process.

Milestones

Product 1:	Annotated Relevant References; first draft, November 15; final draft, December 12
Product 2:	Set of Key Questions; first draft November 6; final draft, November 14
Product 3:	Irrigation Engineering Synthesis Report; outline, end-November; first draft, December 9; final, December 12

Performance Period

The consultancy will begin on or about 6 November 1998 and terminate on 12 December 1998 for a total of six weeks. The total number of days of the consultancy, assuming six day work weeks (working on Saturdays) will not exceed 36.

Contact Persons

The consultant will work under the programmatic supervision of the PEA Team Leader, Mr. Tom Catterson. The contact person for administrative and contractual matters will be the CRS/Ethiopia Country Representative, Ms. Dorrett Lyttle Byrd.

Duty Station and Duration

See attached Ethiopia PEA Draft Schedule.

Scope of Work for PEA Agronomist/Crop Production Specialist

Introduction and Purpose

The Agronomist/Crop Production Specialist will work under the direct supervision of the Team Leader as an integral member of a seven person interdisciplinary team carrying out the USAID/CRS Programmatic Environmental Assessment (PEA) of Small-Scale Irrigation (SSI). These SSI activities are among those presently being carried out with rural communities throughout Ethiopia by the Cooperating Sponsors and supported by PL 480 Title II food aid resources.

In general, the Team will carry out the assessment activities described in the 30 September 1998 Scoping Statement prepared as a prelude to this PEA. These will include: reading and review of relevant documentation, an on-going series of team meetings, site visits and data collection throughout the country, and interviews with key stakeholders in the capital and in the regions. The purpose of the PEA is to develop guidance and build capabilities for the improved identification, design, construction, operation and maintenance of increasingly sustainable (environmentally sound, economically viable and socially acceptable) small-scale irrigation schemes.

It is important to emphasize that this PEA is not an environmental performance evaluation but rather a program level effort to identify key lessons learned from real field experience with small-scale irrigation in Ethiopia. In order to be fully successful, the methodology of the team should be interactive and collaborative with the full range of stakeholders who will be asked to give their frank assessments of the sustainability of SSI.

Team Member Duties and Responsibilities (General)

In order to facilitate the interdisciplinary nature of the team work required for the efficient conduct of this PEA, each individual team member will be responsible for the following tasks:

- Review the existing literature, both Ethiopia-specific and beyond, with the goal of developing **an annotated list of relevant references (product 1)** pertinent to their particular specialized area;
- On the basis of their knowledge of the State of the Art of SSI in Ethiopia, develop **a set of key questions (product 2)** that will be essential to their part of the analysis for the PEA, discuss and revise these questions with the team leader and other team members, in preparation of a field site visit protocol;
- Ensure that these key questions are discussed during field visits, as pertinent, with CS personnel, community and/or irrigation committee members and where possible, with local government representatives, in order to gather the data for their specific analyses; and
- Contributing to the consultative process essential to the satisfactory conduct of this PEA by taking the lead in identifying other individuals (relevant government, non-governmental, cooperating sponsor and donor personnel), as concerns his/her particular specialized area, and maintain a record of those interviewed for inclusion in the PEA report as corroboration of public consultation.

Team Member Duties and Responsibilities (Specific)

In addition to these generic activities, the Agronomist/Crop Production Specialist will assume a leadership role in investigating the agronomics and crop production aspects of small-scale irrigation in Ethiopia and their importance in achieving sustainable investments and developments, with special reference to the following (refer to the List of Issues - Section 3.4.1 in the PEA Scoping Statement for further detail):

- Achievements (planned versus actual) related to increased agricultural productivity, production and income actually realized by farmer participants as a result of small-scale irrigation activities;
- The magnitude of changes in farming systems and agricultural practices and the consequent needs for and availability of improved technologies, improved seeds and plant materials, credit, ag-

ricultural inputs and materials, labor and market opportunities;

- Agrochemical use implications and what is being done related to fertilizers, agrochemicals and integrated pest management;
- Soils choices and small-scale irrigation management and investment results;
- Adequacy of operations and maintenance on these schemes and their impact on productivity and the environment;
- An overview of small-scale irrigation activities and investments and their fit with Govt. of Ethiopia agricultural sector development strategy;
- Identification of agronomy and crop production related issues typical of the small, farmer-managed irrigation schemes being assessed;
- Prepare a series of conclusions and recommendations ("guidance") on how to avoid, address, mitigate and monitor for these issues so as to improve the sustainability of small-scale irrigation investments and developments; and
- Human resources development and institutional capacity needs for small-scale irrigation related agronomics and crop production technologies.

Most importantly, the Agronomist/Crop Production Specialist will be responsible for discussing his findings with other team members so as to contribute to and stimulate his preparations (and those of other team members) of those portions of **a synthesis report related to his particular specialized area (product 3)** as a contribution to the preparation of a draft PEA. This synthesis report will be prepared in accordance with the outline of the PEA as found in section 4.4 of the Scoping Statement. Prior to preparing the individual report, **the Agronomist/Crop Production Specialist will discuss an outline of same with the team leader and other team members** as appropriate.

In addition, the Agronomist/Crop Production Specialist will **carry out any other agronomy and crop production related studies and activities as may be identified** and agreed in consultation with the team leader during the study process.

Milestones

Product 1:	Annotated Relevant References; first draft, November 15; final draft, December 12
Product 2:	Set of Key Questions; first draft November 6; final draft, November 14
Product 3:	Irrigation Engineering Synthesis Report; outline, end-November; first draft, December 9; final, December 12

Performance Period

The consultancy will begin on or about 6 November 1998 and terminate on 12 December 1998 for a total of six weeks. The total number of days of the consultancy, assuming six day work weeks (working on Saturdays) will not exceed 36.

Contact Persons

The consultant will work under the programmatic supervision of the PEA Team Leader, Mr. Tom Catterson. The contact person for administrative and contractual matters will be the CRS/Ethiopia Country Representative, Ms. Dorrett Lyttle Byrd.

Duty Station and Duration

See attached Ethiopia PEA Draft Schedule.

Appendix C
Team Building Efforts for Programmatic Environmental Assessments

Because of the somewhat innovative nature of this PEA and the likelihood that similar PEAs will be undertaken by the worldwide community of Cooperating Sponsors using USAID provided Title II resources for development projects, the steps taken to build the capacity and methodology of the PEA Team for this endeavor are recorded here.

With the field work and data collection of the Ethiopia Small-Scale Irrigation PEA now completed, it would be useful to review some of the things that might help anyone interested to get off on a good foot in future PEAs. Much of this is learning from the ground-breaking efforts on this first small-scale irrigation (SSI) PEA, although parts are also clearly only common sense. It will be important to do the following things, most of which come after the preparation of the Scoping Statement, to prepare for the actual implementation of a PEA.

Scopes of Work

Prepare clear SOWs for each of the team members. The Team Leader should consider circulating them among the team members as part of team building, so that each understand the roles of the others. One might do the same for their curriculum vitae as well, so the team members get to know each others skills and experience.

Team Building Exercise

Given the fact that it is unlikely that anyone on a PEA team has ever participated in a similar exercise, the team leader should work with the team for a few days to go over the nature of the exercise. It is important to emphasis the need to focus on, *inter alia,* the fact that the team is trying to identify the negative environmental issues, the fact that this is not a form of project performance evaluation, to review the findings and directions of the Scoping Exercise, and to point out the tools that will be on hand during the actual PEA exercise.

Basic Reference Materials for PEA Team Members

It is suggested that the Team Leader ensure that each member of the PEA Team have his/her own personal copy of each of the most important references found for the exercise, starting with the basic documentation available from USAID, including Africa Bureau's *Environmental Guidelines for Small-Scale Activities in Africa*, the *Environmental Documentation Manual*, the CRS/FAM Guide to Reg. 216, etc. There may also be useful documents of a country or topic specific nature (in addition to the copy of the PEA Scoping Statement that each team member should have) that would be useful for the Team. For example, the proponent organization might acquire multiple copies of the DFID Small-Scale Irrigation Planning Guide and of the Vincent Book on Hill Irrigation and distribute them to the team. It would be useful for the team to carry some extra copies of the Scoping Statement with them as interests are inevitably kindled in the field about the nature of this work.

Team Composition

It does not appear that an economist is needed on the Team; this is an area that the Team Leader should be able to cover. The rest of the team skill areas as used in Ethiopia would also be useful if one was to encounter such a big and extensive SSI program. Each team should be selected on the basis of the findings of the Scoping Exercise— one of its objectives.

Core PVO/NGO Country Staff on the Team

In order to make progress in building up organizational skills for these sorts of activities, it would be most useful to have at least one core organization country staff member as part of each Team. This is also an advantage in dealing with issues that arise that are beyond the mandate of the PEA Team.

Team Working Folders

In order to facilitate Team interactions and meetings, it was suggested that each Team member assemble all their team handouts in a "Working Folder." Although this did not work out as planned in Ethiopia (one team member lost his folder!), it is worth reiterating the usefulness of this tool. Here again, the challenge and the opportunity is getting the team to work together. Often the solution to one or another of the impacts identified could be suggested by another team member, e.g., irrigation engineering solutions to environmental health issues. In part, it is the difference between having a multi-disciplinary team and having an inter-disciplinary team.

Team Contracts/Support Provisions

Because of the rather innovative nature of these PEAs, it is suggested that a proponent organization adopt a fairly flexible approach to defining the contract level-of-effort for external consultants hired in-country. A contract with an NTE date and level of effort is recommended as the way to go, i.e., a contract period and a maximum amount of days. The actual use of the latter could be agreed ultimately between the Team Leader and the Organizational Country Representative or his/her designate. It is also important to be sure external consultants fully understand the per diem and hotel rates and procedures, and that an advance is prepared in a timely way to allow field work to begin as scheduled.

Briefing/De-Briefing Meetings with Concerned In-Country Staff

The USAID/Ethiopia Mission FHA staff suggested that the Directors of the Cooperating Sponsors there be provided with Briefings and De-Briefings cum Preliminary Findings. Although these were extra tasks not originally foreseen (particularly the former), they worked out well, especially given the "public consultation" posture one must endeavor to include in the PEA methodology. Although there may not be as many other organizations involved in other countries, it is suggested that plans for these presentations be included as a routine part of the PEA procedures. In both cases, a written invitation and accompanying explanatory note cum agenda was prepared to facilitate the interchange during the meeting.

Briefing Sheet for Host Field Staff

It might also be useful to prepare some kind of briefing sheet for the field staff with whom the PEA Team will be meeting and interacting (this was something not done in Ethiopia but with some perfect 20/20 hindsight would have been useful). It would/should be similar to the brief prepared for the team members mentioned above, so as to ensure that field staff know that:

- The PEA is not an evaluation and thereby they don't need to hide the imperfections;
- They are able to best participate in the exchange/ consultation and contribute to the lessons learned. (The key question: "If you had to do it again, what would you change?");
- The PEA Team is focusing on the environmental impacts but will also be interested (legitimately) in the sustainability issues and why ("You don't try to mitigate mistakes."); and
- They are best able to arrange for the Team to see the full SSI system and meet with other players and the user community.

Site Profile Pro-Forma

(Please see example from Ethiopia, which perhaps could be improved.) The PEA Team Leader should ensure that it gets distributed and filled out well before the Team is to visit the site, so that efforts on-site can concentrate on the analysis rather than on just trying to understand what is happening on the site. In Ethiopia, some of the field staff, although quite familiar with the actual site, did not have core information easily available on the background to the activities.

Realistic Field Trip Schedules/Itineraries

During the planning of the PEA, it necessary to carefully review the proposed itinerary/schedule of field visits to make sure that the PEA Team will be able to get a reasonable sample frame, that each of the visits is practical (know how long it takes to get to a site and look at a map to put together a reasonable travel program— more time on the sites and not just in the vehicles travelling from one site to another). Knowing the distance to a site is not enough; one needs to know how long that particular stretch of road takes to travel. The program should be quality site visit oriented, not number of sites visited. Where possible, the Team should ask that someone knowledgeable about SSI within the host organization be present with them in the field.

Site Visit Protocol

Something important in these field visits, particularly with larger teams, is to rehearse how the Team will go about getting the information they require. The experience in Ethiopia suggests that the Team tends to "clump" around an issue, sometimes not giving attention to other parts of the review mandate. Also, some of the information, e.g., for the environmental health status, may only be available off-site and require a special arrangement to obtain it.

Weekly Field Visit Synthesis Meetings

One of the most useful exercises employed during the Ethiopia SSI PEA was a series of weekly synthesis meetings to review among the team's preliminary findings and issues. This cross fertilization of ideas among the team members stimulated thinking by the whole Team. An attempt was made to carry out this team meeting before leaving the area, and where possible to share it with the host organization personnel. On at least a few occasions, the local staff found it stimulating as well.

Knowledgeable People and Pertinent References

During the actual PEA, the Team will need to continue to ask questions that seek to identify knowledgeable individuals and pertinent literature, for possible additional meetings. It would not suffice if the Team were to miss the guru for the development activity being assessed in a given country.

USAID/Mission Involvement

It is very important to be clear about whether the USAID Mission personnel are interested in participating in the PEA or at a minimum being kept informed about what is happening. That includes both the Food for Peace staff and the Mission Environmental Officer, at a minimum.

Appendix D

List of Relevant Literature*

Dougherty, T.C. and A.W. Hall. *Environmental Impact Assessment of Irrigation and Drainage Projects*. FAO Irrigation and Drainage Paper No. 53. Rome: Food and Agriculture Organization of the United Nations (FAO), with Assistance from Overseas Development Administration of the United Kingdom (ODA), 1995.

Field, W.P. and F.W. Collier. *Checklist to Assist Preparation of Small-Scale Irrigation Projects in Sub-Saharan Africa*. Wallingford, Oxon, U.K.: Report prepared by H.R. Wallingford Ltd. Institute of Hydrology, for the U.K. Department of International Development, March 1998.

Steinberg, D.I. with C. Clapp-Wincek and A.G. Turner. *Irrigation and AID's Experience: A Consideration Based on Evaluations*. AID Program Evaluation Report No. 8, Washington, D.C.: USAID/Bureau for Program and Policy Coordination. August 1983.

USAID, *Mitigation Practitioner's Handbook*. Washington, D.C.: USAID/BHR/Office of U.S. Foreign Disaster Assistance. October 1998.

Wyatt, Alan, et al. *Environmental Guidelines For PVOs and NGOs: Potable Water Sanitation Projects.* Arlington, Virginia: U.S. Agency for International Development. Water and Sanitation for Health Project (WASH), 1992.

* Additional to those listed in the Scoping Statement Annex C.

Appendix E
Field Visits and PEA Team Activities

Date	Activity
11/3	Meetings with CRS/Ethiopia staff- PEA Preparations
11/4	Mtg. w/ C. Bingham, USAID Environment Adv.; prepare team building materials
11/5	Meetings with USAID/Ethiopia FFP & Ag Office staff plus PEA Team meeting
11/6	Team Building Meeting and with C. Bingham
11/7	Discussion/Revisions PEA Report outline w/ C. Bingham
11/8	Departure (by road) for field trip to Southern Administrative Region
11/9	Field visit to World Vision SSI sites in Omosheleko
11/10	Travel to Awassa; meetings with SAERSAR, ESRDF & Bureau of Agriculture
11/11	Travel to Arba Minch; field visit to Ella SSI site & Water Technology Institute
11/12	Field visit to World Vision Wajifo SSI site w/ continuing travel north
11/13	Travel Ziway to Addis Ababa; PEA Inception Briefing Meeting for CS Directors
11/14	Team Meeting- Synthesis of Trip to South; preparation of Team memo
11/15	Preparation of Team working documents, memos, and e-mails; reading documents
11/16	Travel (by air) to Dire Dawa; Field visit to HCS SSI site in Lege Oda
11/17	Field visits to several HCS SSI sites (mostly spate irrigation)
11/18	Field visits to LWF SSI site at Daawa & CARE SSI site at Tourbi
11/19	Field visit to CARE SSI site at Chulol
11/20	Team Meeting- Synthesis of trip to Hararghe; travel (by air) Dire Dawa to Addis
11/21	Reading reference materials; prepare team memo; prepare e-mails
11/22	Prepare Team memorandum and complete arrangements for trip to North
11/23	Travel (by air) to Bahir Dar; meetings with CO-SAERAR
11/24	Travel by road to Ibnat; Field visit to CO-SAERAR SSI site at Zanna
11/25	Travel (by road) Gondar to Simada; Field visit Food-for-Hungry (FHI) SSI site
11/26	Field visit to FHI SSI site at Tach Gayint
11/27	Synthesis Meeting- Amhara Region field visits
11/28	Travel (by road) Lalibella to Mekelle; stopover in Maichew to visit EOC staff
11/29	Working on administrative matters; team report outline discussions
11/30	Meeting with Relief Society of Tigray staff; visit to REST SSI site- Mai Leba dam

Date	Activity
12/1	Field Trip to Agbe Diversion Scheme; mtgs.- ADCS and REST
12/2	Meeting with CO-SAERT; p.m.- field visit to SAERT sites west of Mekelle
12/3	Field visits to SAERT sites to southwest of Mekelle; feedback mtg. w/ REST
12/4	Team Synthesis Meeting- Tigray visit; travel Mekelle to Addis Ababa
12/5	Preparation Sub-team report outlines; mtg. w/ French consultants to REST
12/6	Administrative Housekeeping; mtg. w/ F. Brockman on Sub-Team Reports
12/7	Team meeting to discuss findings/reporting; mtg. w/ USAID/Ethiopia FHA staff
12/8	Team progress meeting ; mtgs. w/ MWR & Mr. Korfa- House of People's Reps.
12/9	Drafting Sub-team reports; C. Bingham arrives; discussions w/her on PEA progress
12/10	Working on PEA Report outline w/C. Bingham; mtgs. CIDA & Policy Unit- MWR
12/11	Team discussions- sustainability issues; mtg. w/ Ato Yonas of EPA
12/12	Discussions w/C. Bingham re: preliminary findings/completion of Ethiopia PEA
1213	Preparation Agenda/De-Briefing Note for CS workshop; Review Envir. Health Rpt
12/14	Team Meeting on Sustainability; Review of Draft Sub-Team Reports
12/15	Preparations for De-Briefing Meeting; De-Briefing Meeting
12/16	Mtg. w/ World Food Programme; pull together team report pieces
12/17	Drafting PEA report pieces; wrap-up arrangements; Team Leader departs.

Appendix F

List of Persons Consulted

In Addis Ababa

Name/Position	**Organization**
Dorrett Lytle-Byrd, Country Representative	CRS/Ethiopia
Bob Leavitt, Asst. Country Representative	CRS/Ethiopia
Ann Bousquet, Asst. Country Representative	CRS/Ethiopia
David Eckerson, Deputy Director	USAID/Ethiopia
Herbie Smith, FHA Office Chief	USAID/Ethiopia
Carrell Laurent, FFP Officer	USAID/Ethiopia
Tadele Gebresellasie, Ag. Sector Officer	USAID/Ethiopia
Margaret Brown, Mission Environmental Officer	USAID/Ethiopia
Derishe Mamo, Planning Officer	EOC/DIDAC
Takele Teferra, Head, Relief and Development	EOC/DIDAC
Meknoone Meshesha, Commissioner	EOC/DIDAC
Abadi Amdu, Conservationist	EOC/DIDAC
Gessesse GebreMedhin, External Relations Officer	REST
Kenneth Byrd, Country Representative	Africare/Ethiopia
Haile Wubneh	Africare/Ethiopia

In Addis Ababa

Name/Position	**Organization**
Haddish Asgedom, Program Coordinator	EOC/DIDAC
Merid Kebebe, Program Coordinator	WV/Ethiopia
Demissie Lesanework, Technical Coordinator	FHI/Ethiopia
Endalkachew Getaneh, Co-Director of Programs	FHI/Ethiopia
Paul Erickson, Country Director	FHI/Ethiopia
John Hoare, Food Sector Coordinator	CARE/Ethiopia
Mulugeta Abebe, Country Director	WVI/Ethiopia
Nassirou Ba, Food Security Officer	SCF/USA- Ethiopia
Doug Clements, Food Policy Advisor, Project Support Unit	CIDA
Haiminot Assefa, Environmental Advisor, Project Support Unit	CIDA
Daniel Molla, Food Security Advisor, Project Support Unit	CIDA
Negash Gemtessa , Head, Design Department	Ministry of Water Resources
Sahle Sisay, Head, Policy Department	Ministry of Water Resources

In Addis Ababa

Name/Position	Organization
Jacky Astier, Hydrology Expert	BRL Ingenierie (Consultants to REST & AFD)
Korfa Garane Ahmed, Member	House of People's Representatives
Stephen Anderson, Development Coordinator	World Food Programme
Mulugeta Dijean, Program Manager	WV/Ethiopia
Tarekegn Abose, Entomologist, Department of Vector-Borne Diseases	Ministry of Health
Shibru Tedla, Schisto Specialist	Environment Consultant

In Omosheleko

Name/Position	Organization
Aweke Degaga, Project Agriculturalist	WV/Ethiopia
Abou Tefera, Irrigation Engineer	WV/Ethiopia

In Awassa

Name/Position	Organization
Meskelle Ayele, Commissioner	CO-SAERSAR
Getahun WoldeMaskal, Head	ESRDF Regional Office
Tadesse Makonnen, Head, Rural Infrastructure	ESRDF Regional Office
WoldeMichael Dubale, Team Leader, Extension	Regional Bureau of Agriculture

In Humbo Woreda

Name/Position	Organization
Zakarias Langana, Team Leader, Extension	Office of Agriculture

In Ella

Name/Position	Organization
Zewdu Boltena, Health Assistant	Ella Irrigation Project

In Toonto

Name/Position	Organization
Senait Asmelash, Senior Clinical Nurse	Toonto Clinic

In Arba Minch

Name/Position	Organization
Hailemariam Dessalegn, Dean	Arbaminch Water Technology Institute

In Me'erab Abaya/Wajifo

Name/Position	Organization
Debebe Taye, Program Development Coordinator	WV/Ethiopia, North Omo
Taye G/Egziabher, Communication/Liaison Officer	WV/Ethiopia, North Omo

In Dire Dawa

Name/Position	Organization
Bishop Wolde Tensay, Head	Hararghe Catholic Secretariat (HCS)
Paolo Pironti, Consultant	HCS
Belhu Legese, Agr./NRM Coordinator	HCS
Zemede Abebe, Agr. Technician	HCS
Helina Mikre, Agr. Technician	HCS

In Dire Dawa

Name/Position	Organization
Mesfin Alemayehu, Agr. Animator	HCS
Wondwosen Tamrat, Health Coordinator	HCS
Wondirad Legesse, Health Assistant	Lofto Clinic

In Garemuleta

Name/Position	Organization
Jabir Ahmed, Irrigation Engineer	CARE
Alemayu Tadesse, Project Coordinator	CARE
Tedla Assefa, Asst. Project Coordinator	CARE
Amde Kidenewolde, Monitoring and Evaluation Off.	CARE

In Bahir Dar

Name/Position	Organization
Mulugeta Seid, Commissioner	CO-SAERAR
Yacoub Wondemoreh, Irrigation Specialist	CO-SAERAR
Akalu Arega, Community Mobilizer, Zanna Project	CO-SAERAR
Natalie Gomes, Researcher	Medecin Sans Frontier

In Simada

Name/Position	Organization
Solomon Wolde, Irrigation Engineer	FHI/Ethiopia
Zelalem Letyibelu, Irrigation Engineer	FHI/Ethiopia
Eshetu Demissie, Agriculturalist	FHI/Ethiopia

In Simada

Name/Position	Organization
Alemayehu Wassre, Forester	FHI/Ethiopia
Jean Gaillard, Irrigation Program Coordinator	FHI/Ethiopia

In Tach Gayint

Name/Position	Organization
Solomon Hailu, Irrigation Engineer	FHI/Ethiopia

In Mekelle

Name/Position	Organization
Teklewoini Assefa, Director	REST
Negash Berhe, Head, Environmental Rehabilitation	REST
Tsehaye Gebresellasie, Forester	REST
Mulugeta Berhanu, Head, Agricultural Development	REST
Kahsay Girmay, Head, Operations Construction Unit	REST
Salih Said, Head, Operations Construction Unit	REST
Tesfaye Alemseged, Environmentalist	CO-SAERT
Hailay Tsige, Senior Agriculturalist	CO-SAERT
Teweldeberhan Hailu, Head, Health Division	REST
Tewodros Adhanom Ghebreyesus, Head, Malaria Control	Tigray Health Bureau

In Adi Godum

Name/Position	Organization
Meresa Abadi, Development Agent	Regional Bureau of Agriculture
Mehari Kahsay, Development Agent	Regional Bureau of Agriculture

Appendix G
Useful Annotated References and Sources of Information on SSI in Ethiopia

Soils, Agriculture and Small-Scale Irrigation Topics

The Soils of Ethiopia – Annotated Bibliography

Berhanu Debele (editor). Published by SIDA's Regional Soil Conservation Unit (RCSU), Addis, 1994.

An excellent source for locating important publications on the soils (and closely related subjects) of Ethiopia. It contains annotations for approximately 1,100 published works, grouped in four broad categories: field studies, research and program implementation.

It may be the place to start looking if you have information needs related to soils and SSI. It provides information on studies carried out in the major river valleys (Blue Nile, Awash, Wabe Shebele, Tekeze-Setit-Mereb-Gash-Barka, and the Omo) as well as those conducted on some of their tributaries. There are also area specific studies on topics such as the Rift Valley lakes, Setit Humera, Gambela area, Central Tigray and the Shire lowlands. It also features reference citations from some of the better known country level studies, such as the Ethiopian Highlands Reclamation Study (EHRS), the Land-Use Planning and Regulatory Department (LUPRD) Project, and about the activities of the International Union for the Conservation of Nature (IUCN) in Ethiopia. It provides a listing of some of the publications resulting from soil related research carried out by the Institute of Agricultural Research (IAR), Alemaya University of Agriculture (AUA), the Soil Conservation Research Project (SCRP) and the then International Livestock Center for Africa (ILCA), now the International Livestock Research Institute (ILRI). Most useful are the cross-referenced indices which enable the user to easily locate documents and publications that may be of interest. For example, it lists 14 different publications that deal with the issue of soil salinity in Ethiopia.

Small-Scale Irrigation Projects (SSIP) Technical Handbook

Prepared for the Ethiopian Social Rehabilitation and Development Fund (ESRDF) by Continental Consultants P.L.C. (an Ethiopian Consulting Company) and Consulting Engineering Services (India) Pvt. L.T.D. Addis Ababa, 1997.

A four volume set of manuals which systematically addresses all facets of the planning and implementation of small-scale irrigation systems in Ethiopia. Any organization seriously committed to promoting and developing SSI in the country should have multiple copies available for field staff. Although it is often extremely sophisticated and overwhelmingly engineering-oriented, it presents wide ranging guidance, some of which appears to be based on actual case examples. In other instances, for example, in estimating available surface water resources, it lacks practical guidance about how to use the several formulas for these calculations when real site-specific data are lacking. Nevertheless, it a must acquisition for any of the Cooperating Sponsors currently promoting SSI with Title II resources.

Ways of Water, Run-Off, Irrigation and Drainage

Hugues Dupriez and Philippe DeLeener, 1992.

Provides a very practical explanation of the causes, harmful effects of salinity and describes some of the means for controlling salinity under irrigated farming.

Design and Operation of Farm Irrigation Systems

M.E. Jensen (editor), 1983. Published by the American Society of Agricultural Engineers (ASME), Monograph No. 3.

This document discusses the problem of salinity in terms of its significance and management. It provides good basic information on crop tolerance to salinity. It describes and discusses irrigation water quality, various salinity management techniques, and the procedures for reclamation of salt affected soils.

Surface Irrigation

Booher, L.J. 1974. FAO Agricultural Development Paper No. 95, Food and Agriculture Organization (FAO), Rome, pp.- 160.

Health and Water Development Topics

Guidelines for Forecasting the Vector-Borne Disease Implications of Water Resources Development

Birley, M.H. Joint WHO/FAO/UNEP Panel of experts on environmental management for vector control. VBC/ 89.6, 1989.

Excellent guidelines written to provide a basis for rapid health assessment of water resources development projects for those without specialist knowledge of health. A must for those involved in small scale irrigation projects.

Guidelines for the Incorporation of Health Safeguards into Irrigation Projects Through Intersectoral Cooperation

Tiffen., Mary . Joint WHO/FAO/UNEP/UNHCS Panel of Experts on Environmental Management f Vector Control, PEEM Guidelines Series 1; WHO/CWS/91.2, 1991

Guidelines written for policymakers, planners and managers who are involved in irrigation schemes but who are neither irrigation or health specialists. An overview of the main vector borne diseases associated with irrigation development, the circumstances under which they are likely to pose significant health hazards and a review of the measures that can be taken for their control. Highlights the importance of intersectoral collaboration at different stages in the project cycle. The guidelines examine incorporating health safeguards into large irrigation schemes, schemes with a resettlement component, small scale irrigation and traditional irrigation schemes. The main focus of these guidelines is to prevent increase in water borne and water washed diseases.

The Health Impact Assessment of Development Projects

Birley, M.H. HMSO, UK. ISBN 0 11 580262 2, 1995

Governments and international agencies invest large sums on development projects in energy, agriculture, industry and other sectors. The environmental impact of these projects is frequently assessed. However, often the health impacts receive little attention. This book seeks to redress this balance. It connects reviews and procedures and provides a readily accessible catalogue of health/development linkages. It is intended for a wide audience of people both within the health sector and those working with environment or development. It provides procedures for assessing the health impacts through a wide range of development projects involving transport and communication, mining, energy, agriculture, irrigation, fisheries, forestry, livestock and urban development.

The Implementation and Sustainability of Insecticide Treated Mosquito Nets (IMN) Programs for Malaria Control in Rural Africa - Lessons Learned from the Bagamoyo Bed Net Project, Tanzania

Schiff, C., Winch, P., et al. USAID publication

The Bagamoyo Bed Net project was a five year project (1990 to 1995) examining the impact of IMN, how best to encourage community participation, the impact on malaria transmission and the sustainability of such an intervention. Studies in Ghana and the Gambia have confirmed that bed nets per se can significantly reduce malaria associated childhood mortality. Operational research on the implementation of IMN interventions is at about the same stage as oral rehydration salt interventions were after clinical trails showed their efficacy. This paper examines factors affecting the sustainability of IMN interventions. These include a high level of acceptance in efficacy trials and a high social value associated with bed nets. Households in urban areas already spend money on the prevention and/or treatment of malaria as the cost of the IMNs did not appear to be a barrier. Factors challenging the more widespread use of IMN include the cost of the nets; the fact that they are viewed as mosquito control measure rather than a malaria control ensure; the lack of structure at the village level to assume responsibility for re-treatment with insecticide and the lack of willingness to pay for the re-dipping. This study also noted a lack of strong national and regional government commitment.

Re-Orientation and Definition of the Role of Malaria Vector Control in Ethiopia

Abose, T., Yeebiyo, Y., et al. WHO/MAL/98, 1985; 1998

Outlines the results of a study in the Rift Valley - Zwai

Lake area of Ethiopia whose objectives were to: a) understand the pattern of malaria transmission and drug resistance; b) the ascertain knowledge, attitude behavior and practices of the study population with regard to malaria prevention; c) to determine the distribution of *Anopheles gambiae* complex in Ethiopia; and d) to recommend appropriate vector control strategies. The study comprised 242 households with a population of 1,153 people. The households were divided into 3 zones dependent on their distance from Zwai Lake. The study showed that all ages were affected by malaria and that there was little immunity within the population. The average prevalence of malaria, as confirmed by blood smear, was 6.8 percent (range 3.5 to 12.6 percent). Peak prevalence was seen in September. Sixty-six per cent of infection was caused by Plasmodium falciparum and 31 percent by plasmodium vivax. The zone nearer the lake showed a higher incidence of infection. Different mosquito behavior was observed between *Anopheles arabiensis* and *Anopheles pharoensis,* the former breeding predominantly in smaller rain pools and the latter breeding along the shallow shore water. 71 percent of the man-vector contact with *Anopheles arabiensis* was indoors, whereas 72 percent of man-vector contact with *Anopheles pharoensis* occurred outdoors between 18.00 and 22.00h. The study detected a high resistance to DDT by *Anopheles pharoensis* and a 20-30 percent resistance of *Anopheles arabiensis.* Both vectors were highly sensitive to malathione. There was a 79 percent mortality rate of *Anopheles arabiensis* after home spraying but 55 percent of houses were replastered within six months of spraying decreasing control efficacy. 94 percent of the population recognized malaria as an important disease but two thirds did not know the cause. Most people sought treatment from the nearby malaria clinic. The first line of treatment for *Plasmodium falciparum* was chloroquine but there was a significant percentage of resistance (22 percent RIII resistance and 33 percent RI/RII level resistance) The study highlights the need for community involvement and social mobilization in the control of malaria. The study also confirmed that because the majority of infection occurred indoors due to vector/human contact with *Anopheles arabiensis,* there is a possible role for IMNs.

Community Participation in Malaria Control in Tigray Region, Ethiopia

Tedros Adhnom Ghebreyesus, Tesfamariam Alemayehu, Andre Bosman, Karen Witten, Awash Teklehaimanot. Acta Tropica, 61, 145-156, 1996

During the Ethiopian civil war from 1974-1991, the Tigrean People's Liberation Front established a primary health care system in Tigray in which community residents helped to plan and implement health services through health committees and community health workers (CHWs). To strengthen and update this system., a Community-Based Malaria Control program was initiated in 1992. The primary objective was to reduce malaria morbidity and mortality and to prevent malaria in pregnant women through early diagnosis and treatment of cases, chemoprophylaxis during pregnancy, and vector control by environmental management. This paper reports on progress achieved in these objectives through the work of 681 CHWs who covered a rural population of 1,682,319. The principal success of the programme is the treatment of malaria at village level.

The Effectiveness of Insecticide-Impregnated Bed Nets in Reducing Cases of Malaria Infection: Pilot Studies on the Possible Effects on Malaria of Small-Scale Irrigation Dames in Tigray Regional State, Ethiopia

Tedros Ghebreyesus, Asfaw Getachew, et.al. J. Public Health Medicine, 20, 238-240, 1998.

Describes preliminary findings on the prevalence of malaria in a pilot study conducted in six villages in Tigray, three of which were within 30 minutes walk of an existing earth dam site during October-November 1995. A total of 3,200 persons were registered in the house-to-house survey; blood films were collected from 82 percent of these. The overall prevalence of any type of malaria infection was 2.6 percent, with 81 percent of infections caused by *Plasmodium falciparum* and 19 percent by *P. vivax.* Prevalence varied widely between village with dams and those without. Comparison between the three villages with dams and the other shows a highly significant difference. Care, however, needs to be taken in the interpretation of these results. Superficially it appears that the parasite rates are highly dependent on the presence of dams within the vicinity, but there are other factors which need to be taken into consideration.

Temporal and Spatial Distribution of Anopheline Mosquitos in an Ethiopian Village: Implications for Malaria Control Strategies

Ribeiro, J.M.C., Seulu, F., Abose, T., Kidane, G., Teklehaimanot, A. Bull. WHO, 74, 299-305, 1996

This paper outlines the difficulties of developing effective focal spraying in villages. The spatial and temporal distribution of *Anopheles gambiae* mosquitoes in houses in the village of Sille near Arba Minch, in Ethiopia, was monitored over the period 1990-1991. Monthly mosquito densities in over 300 houses were obtained and the number of mosquitoes trapped plotted on maps. This indicated a clustering of mosquitoes towards the edges of the village, the pattern of which changed with time. For example, the low density of mosquitoes in one area in September increased as the nearby irrigation canals dried up during the following months. Since entomological activity occurred at the periphery of the village, selective control of breeding sites and indoor spraying could provide a more efficient use of limited resources rather than total coverage.

Schistosomiasis in Ethiopia and Eritrea

Ed. Hailu Birrie, Shibru Tedla and Leykun Jemaneh. Institute of Pathobiology, Addis Ababa University, 2nd edition, 1998.

A excellent review of schistosomiasis which covers the parasitology, distribution, possible economic and social implications of schistosomiasis, medical aspects including diagnosis and treatment, malacology and the prevention and control of Schistosomiasis. An essential reference book for those working in small scale irrigation projects in Ethiopia.

Prevention: Environmental Health Interventions to Sustain Child Survival

Murphy, H., Stanton, B., Galbraith. Environmental Health project, USAID, 1996

A concept paper suggesting the inclusion of environmental-based prevention, particularly at household and community levels, in child survival strategies. The paper presents a conceptual framework on the understanding of an epidemiological pathway to illness beginning with the disease agent or vector (e.g. mosquito) and moving through stages of breeding and multiplication, transmission and exposure. The diseases considered in the framework are three childhood diseases with environmental features as well as significance in promoting child survival: diarrheal disease, malaria and acute respiratory tract infection. Each section discusses a range of household and community-level environmental interventions and presents evidence of their effectiveness in the technical literature.

The Use of Health Impact Assessments in Water Resource Development: a Case Study from Zimbabwe

Konradsen F., Chimbri, M., Birley, M., et al. Impact Assessment, 15, 55-72, 1997.

A case study presenting the findings of a health impact assessment (HIA) of a small scale irrigation and dam development project, the Mupfure Irrigation project, in northern Zimbabwe. The paper describes a full health impact assessment. Several health hazards were interpreted as health risks during the HIA. These included schistosomiasis, malaria, agro-chemical poisoning, sexually transmitted diseases, water-washed diseases and malnutrition. Based on the findings of the HIA, safeguards and mitigating measures were suggested and included in the project design. The paper provides a good example of how a health impact assessment can be documented and used in the planning of a project.

Other Useful References

Health Issues in Irrigation Development in Africa - an Engineer's Perspective

Bolton, D. Overseas Development Unit, Hydraulics Research, UK. Paper presented at a Forum on performance of irrigated agriculture in Africa, USAID, Kenya, January 1988.

Man-Made Lakes and Man-Made Diseases - Towards a Policy Resolution

Hunter, J.M., Rey, L., Scott, D. Soc. Sci. Med 16, 1127-1145, 1982

A Rapid Health Impact Assessment of the Turkwel Gorge Hydroelectric Dam and Proposed Irrigation Project

Renshaw, M. Birley, M.H., Sang, D.K. and Silver, J. Impact Assessment and Project Appraisal, 16, 215-226, 1998.

Appendix H

Checklist for Planning Environmentally Sound Small-Scale Irrigation (SSI) in Ethiopia

Introductory Note

This Environmental Planning Checklist has been designed and prepared to assist in the environmental review of small-scale irrigation activities being proposed by the Cooperating Sponsors funded with Title II resources in Ethiopia. The basic premise of this Checklist is that by using it the Cooperating Sponsors will be able to justify the Threshold Determination of Negative with Conditions in their respective Initial Environmental Examinations (IEEs). If the Checklist is used correctly, a number of outcomes will be realized, namely that:

- the Cooperating Sponsors have correctly identified the potential negative environmental impacts associated with the proposed site and all its dimensions;
- they are certifying to USAID that they are cognizant of these impacts and have taken the appropriate steps to avoid and/or mitigate them;
- the completed questionnaire and the information it contains, submitted as part of their IEE, will enable USAID environmental officers to verify that the determination is valid and the activity can be approved; and
- both the Cooperating Sponsors and USAID will be aware of the elements of the activities that will require monitoring over the next few years will be understood.

This Checklist is based on the findings and recommendations described in the Small-Scale Irrigation Programmatic Environmental Assessment (PEA) Report, and in particular to Chapter 5 of that Report. It should be noted that this Checklist is not intended to enable either the Cooperating Sponsors or USAID to give scores or rankings or to compare one proposed small-scale irrigation site with another. It is further assumed (as specified below) that the provisions for supervision and inspection and monitoring procedures related to the typical mitigation needs of small-scale irrigation will be in place. This Checklist is intended as a guided approach to ensuring that the issues related to the environmental soundness of SSI are addressed iteratively as one proceeds through the planning and design steps.

Each of the items of the checklist need to be considered by the Cooperating Sponsor and the information they generate duly recorded. Doing so, will facilitate the preparation of the IEE (or amended IEE); it may also be possible, depending on the outcome of the Checklist use, to append it to the IEE itself and deal in a more summarial fashion with the usual categories of information required by an IEE. Cooperating Sponsors are encouraged to add any other information or categories of data that emerge as important in the preparation of the plan for the development of the scheme in question, and for the further upgrading of this Checklist. Accordingly, it is not expected that the responses to the Checklist should contain all the design information and/or precautionary measures associated with the array of issues related to the feasibility of small-scale irrigation at each site.

It should be further noted that in order to successfully use this Checklist, it is presumed that many of the basic studies, measurements and community consultation regarding the feasibility and design of the proposed site will have already been carried out. The designers of this Checklist believe that it will also serve as a tool for structuring the needed consultation with the community and water user association about the basic design of the SSI site, the potential for negative environmental impacts and the roles, rights and responsibilities of the different parties (community, water users, Cooperating Sponsor, partner Governmental agencies) in addressing these impacts, and the agreements to be achieved among all parties to ensure the sustainability of the activity/investment.

Environmental Planning Checklist for Small-Scale Irrigation

1. Small-Scale Irrigation Site Identification and Characteristics (fill in the blanks)

Date Project Planning Began:____

Expected Completion Date:_____________Present Status:____

Site/Community Name:____

Location (Region, Woreda, Village):____

Approximate Altitude of Scheme:____________________(masl): Agro-ecological Zone: __________________

Cooperating Sponsor:____

Brief Project History (proposed by, how identified, by whom):____
____

Community Concurrence:______________How Reached:____

Water User Association Established:________________________________

How Established:____Date:_______________

Number of Beneficiary Participants in WUA:_________________________

Number of Males:_____________________Number of Females:_______________________

Percentage of Total Community to be Included in Scheme:____________________________

Area to be Irrigated:_________________(hectares)—Type of Irrigation (Spring, Diversion, Storage, Spate, or Lift):____

Average Size of Household Irrigated Plot:______________ (hectares)

Previous Use of Irrigated Area:____

Is this (Check all that apply): a New Scheme:________, Rehabilitation of Traditional Scheme:________, Upgrading of Traditional Scheme: ________, Rehabilitation of Modern Scheme: ________

Proposed Crops- Wet Season:___________________________, Dry Season:___________________________

Average Household Holdings Outside the Scheme:____

Other Major Infrastructure or Investments linked to SSI: ____

____(e.g., roads, potable water, watershed management)

What is the total cost of the scheme: ________; broken down by cash costs:_________________

food aid cost equivalents:_________; community contribution in labor and in kind:___________

Estimate the costs in either US Dollars or Ethiopia Birr. Include all necessary investments required for the scheme to operate. Food aid costs should be calculated by multiplying the number of person/days of labor by the equivalent value of the day's ration. Community contribution should be accounted for, including contributed free labor if any and the estimated value of the materials provided (stone, sand, soil, etc.).

What is the expected unit cost per hectare of irrigable land within the command area during the dry season:____________$/hectare.

What percentage of the annual operating budget, for the Woreda:_________, for the local area:__________, for the program of the Cooperating Sponsor:_________________________

Sketch Map Included: (to scale at 1:10,000 or larger).

2. Analyzing the Basic Parameters

Prepare a brief narrative response for all of the headings below that apply to the site.

Water Resources Availability

– How much water (lts/sec) is available for irrigation purposes?

– Is there an historical record of river/stream hydrology (yes/no) and how compiled?

– If not, how was amount calculated (briefly describe method); an additional sheet showing calculations should be added?

– Are there upstream users of the water, or could there be (explain)?

– Are there downstream users and how do they use water?

– Are they actively pursuing irrigation; using water for potable water supply or for animal consumption; Estimate their requirements (lts/sec)?

– How were downstream users consulted?

– What percentage of stream flow will be abstracted during lean period?

Other Uses and End Users

– Has the potential usage by people or animals been factored into the calculations of water use within the scheme, and if so, how so?

– Will the scheme attract additional herders and their animals in search of water, including from beyond the present community?

– Is there a need for maintaining minimum ecological flow during lean season; if not, why not?

– What precautions are being undertaken to guard against unnecessary leakage/evaporation within the scheme?

– Describe the methods by which D.A.s/WUA and the users themselves will measure/know about the annual/seasonal/periodic water availability.

Catchment Status

– What is the size of the catchment that supplies water to this scheme (estimate) in hectares?

– What is the present land-uses of the catchment (a sketch map may help to illustrate this point)?

– What is the condition of the catchment (good or natural, slightly degraded, moderately degraded, highly degraded, being rehabilitated)?

– Do the present activities include rehabilitating/ improving the catchment, and if so what will they entail?

– What percentage of the catchment will be treated each year, and by whom?

3. Estimating Crop Water Requirements

Prepare a brief narrative response for all of the headings below that apply to the site.

– What crops will be planted and which season?

– Crop water requirements per Hectare?

– An additional sheet describing likely crops and their water requirements in different seasons could be added.

– What source of information for the crop water requirements, describe?

– Which publications are the basis for this estimate of crop water requirements or how else was these amounts determined?

– What will be the likely percentage mix of the main crops, during the wet season and the dry season?

– How will the size of the command area change from wet season to dry season?

– Are there expectations/intentions about building up the command area during the break-in stage of implementation (explain)?

– Are these crops that are familiar to the users?

– In years of poorest rainfall, estimate what will be the area of irrigable land; and how will the cropping pattern change during the dry season (explain)?

– What are the expectations regarding production increases, in a good rainfall years (percent increase) and in a poor rainfall year (percent increase); worse case scenario (explain)?

– Give some examples of the expectations regarding increases in yield, by crops.

4. Farm/Scheme Land and Water Management and Conservation

Prepare a brief narrative response for all of the headings below that apply to the site.

- Do the proposed users have experience with SSI?
- Will there have to be land re-distribution (explain-regularly/annually/periodically)?
- What sort of water management technology will be used within the irrigated plots?
- Will the users be able to maintain the fertility of their irrigated plots, and how will they do so?
- What is the average slope of land within the command area?
- Will soil conservation measures within the scheme be required, and if so, briefly describe them?
- Are there indications of salinity problems in nearby similar SSI schemes?
- What did the measurements of water quality reveal (gms./lt), and of soil salinity (salinity class)?
- Is salinity likely to become a problem in this scheme, and if so, what measures will be taken to manage the problem (describe)?

5. Post Construction Follow-Up and Technical Assistance

- Will the farmers have to depend on support from Development Agents from the Regional Bureau of Agriculture for extension services?
- Are they available?
- Have the D.A.s been specifically trained in irrigated agriculture; have they received training specific to this site and its operations?
- Do the D.A.s need transport to reach the scheme and do they have it?
- Is there an operations manual to guide extension services?
- What other services will be provided by the D.A.s?
- Briefly describe the training provided and planned for the Water Users Association Officers and Users.
- Is there a water user's fee system and what are its principles (briefly describe)?
- Briefly describe the operations and maintenance requirements of the scheme and who will be charged with their implementation.
- What level of technical assistance from the Cooperating Sponsors will be required by the Water Users Association during the start-up phase of the irrigation activities?
- Have resources (staffing and budgetary) been set aside for this purpose?

6. Water Related Disease Hazards

- Has an environmental health assessment been part of the planning for this scheme, and if so, briefly discuss its results?
- Because of the importance of this particular theme, particularly at lower altitudes, the Cooperating Sponsor could provide a citation of the study findings as a supplement to their response to this section of the checklist.
- Is there health baseline data set available for the community and what are its most important quantitative findings (provide a list)?
- Briefly discuss expectations regarding community vulnerability.
- Briefly discuss expectations regarding environmental receptivity.
- Briefly explain the status of health services in the community, and are there plans for upgrading these services (describe these plans).
- What percentage of the community has access to potable water and where do they normally obtain it, in wet season and in the dry season?
- Does the program of the Cooperating Sponsor in this community, include a potable water supply component (briefly describe)?
- Is there a community specific nutritional baseline available?
- What are the household level nutritional goals of the scheme (describe)?
- How will these goals explicitly be achieved (describe)?

- What measures will be taken for provision of potable water for the work force during construction and for training the work force on water related disease hazards (describe)?

7. Displacement and Land-Use Changes

- Will there be displacement of farm plots as a result of scheme construction, and if so briefly describe (no. of households affected/area of land affected)?
- Will the command area change/shift as a result of rehabilitation or upgrading, and if so, briefly describe?
- What measures are planned to account for these displacements/changes (describe)?
- What percentage of the command area is likely to be devoted to cash crops and which ones?
- Where and how will these cash crops be marketed and by whom (describe)?
- What are the expectations regarding prices for these cash crops, transport and marketing costs, returns to the farmers (describe with as much quantitative data as possible)?

8. Monitoring Plans

- What indicators will be monitored to ensure that the activities are not leading to unforeseen adverse environmental impacts?
- Which of the planned mitigative measures (see below) will require further specific monitoring to be sure they are effective and how will this be done?
- How will environmental monitoring be linked to performance monitoring so as to avoid needless duplication of efforts and meeting reporting requirements?

9. Mitigative Measures Planning

- Identify the specific adverse environmental impacts foreseen during planning and describe the mitigative measures for each.
- How have the costs of these measures been factored into the feasibility considerations for the scheme in question?
- Will there be resources available for post-construction mitigation measures and who will provide for them?

Appendix I

Bureau Environmental Officer's Approval of PEA